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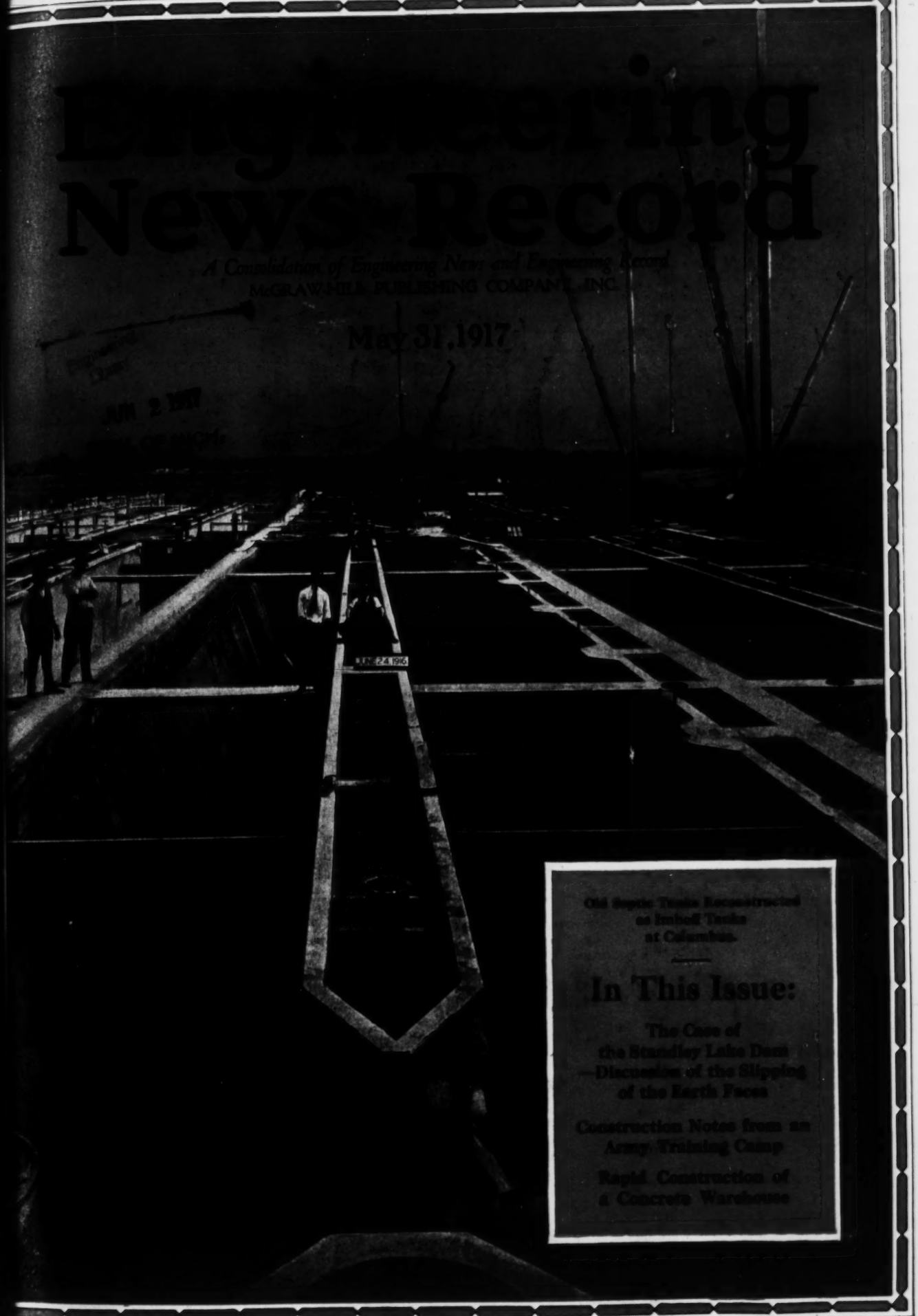


Old Supply Tanks Reconstructed as Imhoff Tanks at Columbus.

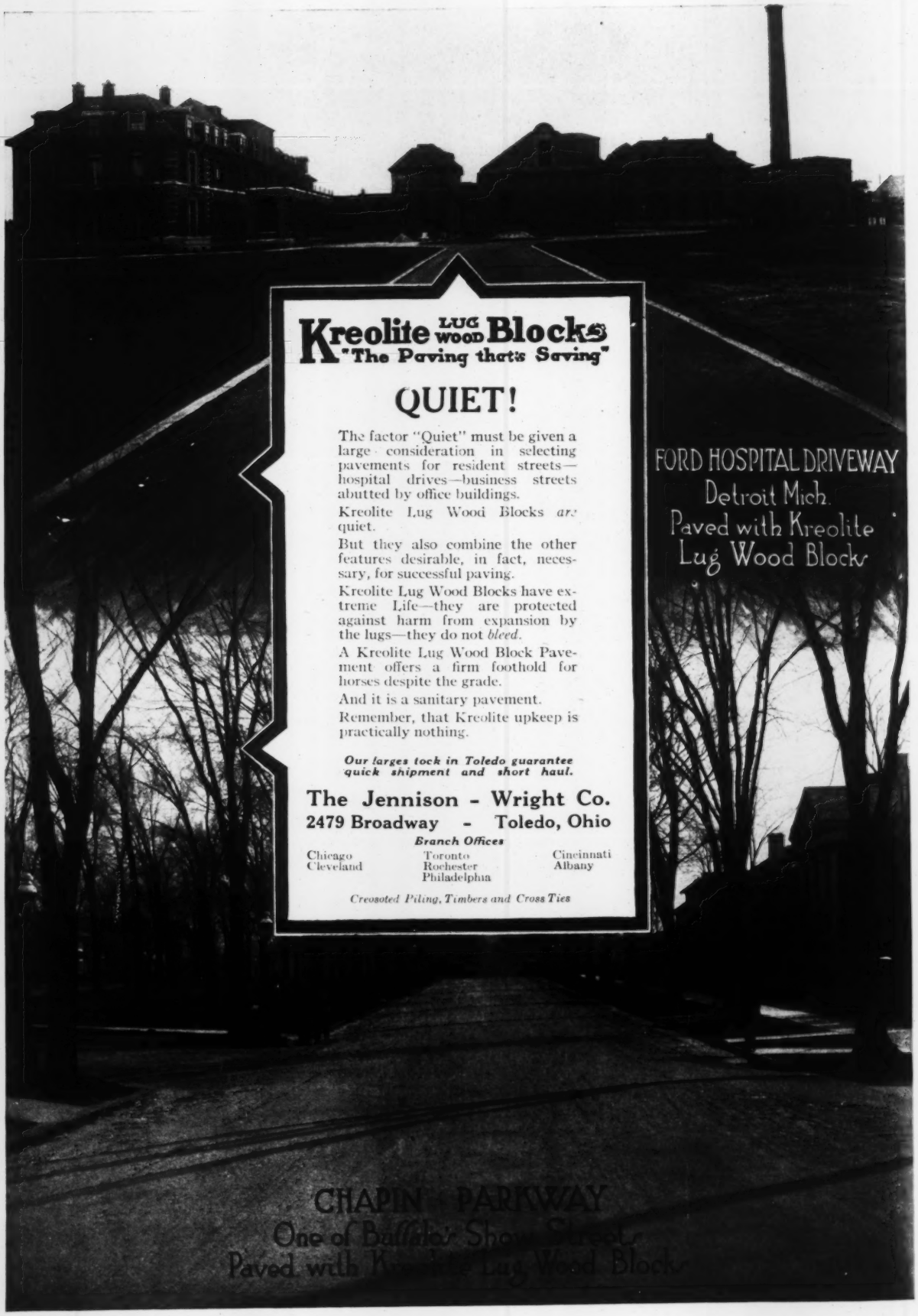
In This Issue:

The Case of the Standley Lake Dam —Discussion of the Slipping of the Earth Faces

Construction Notes from an Army Training Camp

Rapid Construction of a Concrete Warehouse

Cover released by courtesy of Concrete Steel Co., New York City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Engineering News-Record

A CONSOLIDATION OF ENGINEERING NEWS AND ENGINEERING RECORD

A Weekly Journal Devoted to Civil Engineering and Contracting

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Suspension Bridge Solves Problem of Crossing Rio Chiriqui in Panama

Highway Crossing Over Torrential Stream Required Span of 410 Feet—Ox-Cart Haul of 7½ Miles a Critical Factor

By A. S. ZINN

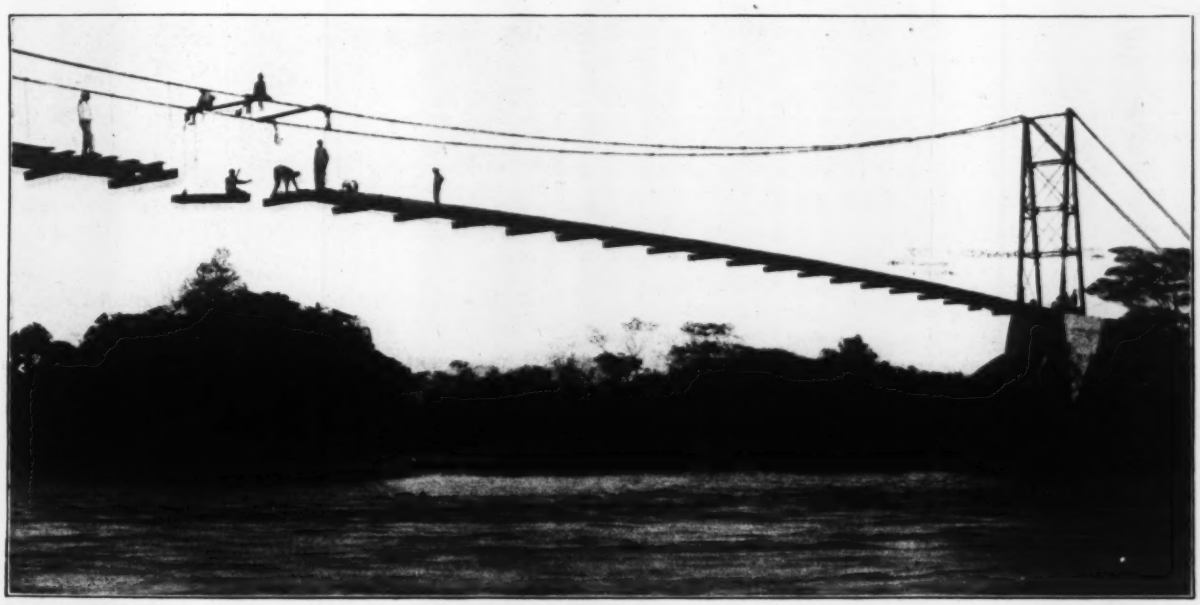
Consulting Engineer, Chicago

ACROSS the Rio Chiriqui in Panama there is a suspension highway bridge with a single 410-ft. span. This choice of structure is due to the torrential nature of the river and was arrived at after a center pier in course of construction for a two-span suspension bridge had been washed out by a sudden rise of the stream. The material for the bridge was loaded and reloaded four times in its journey from New York and reached its final destination by a 7½-mile ox-cart haul over very bad roads. Anticipating the great difficulty of getting experienced men for field riveting, the structure was designed to be completed with bolts and nuts.

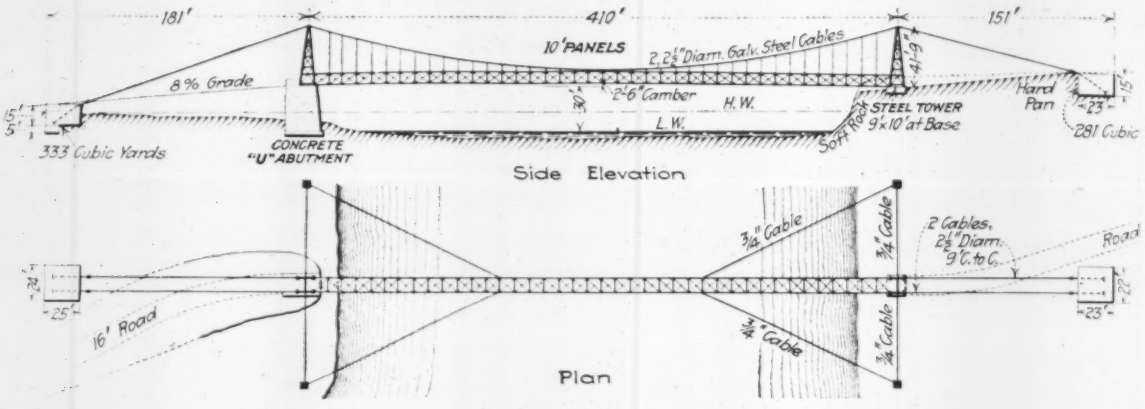
Six months after the contract was let for the construction of the Chiriqui Ry. for the Republic of Panama, the writer, who was then consulting engineer to the Government, recommended the construction of a light wagon bridge over the Rio Chiriqui, in order to connect a rich country east of the river with the new railway about six miles west of the river. The project was approved, and investigations were made at once to decide on the location and kind of bridge that would serve the purpose for the next 30 years at the least possible cost.

The bed of the river is full of boulders, 1 ft. to 6 ft. in diameter, making it impossible to drive sheet piling for pier foundations. At the bridge site the river slopes 150 ft. to the mile, and at time of high water the flow velocity is more than 20 ft. per sec. The rainy season covers a period of eight months each year, during which time the rainfall is about 140 in., in an average year. The river has been known to rise as much as 15 ft. in a few hours, at the time of a heavy rain.

During the administration of President Obaldia the government attempted, in 1909, to build a two-span suspension bridge near the present location. After the cables were delivered and the pier and abutments were completed, at a cost of about $10,000, a sudden rise in the river washed out the center pier, and the work was abandoned.



FLOOR STEEL PLACED PANEL BY PANEL AFTER FOUR 2¾-INCH MAIN CABLES WERE HAULED ACROSS ON ¾-INCH TEMPORARY CABLES



DESIGN OF CHIRIQUI RIVER SUSPENSION BRIDGE GOVERNED BY LONG OX-CART HAUL. TOWER AND FLOOR GUY CABLES PROVIDE AMPLE STABILITY

In view of these conditions a single-span suspension bridge was decided on for the new structure. It was the consensus of opinion that the heaviest loads the bridge would ever be required to carry would be a drove of 40 to 50 cattle or a 10-ton road roller. As the road roller would no doubt be the heaviest load on a panel, the bridge was designed accordingly, with the factor of safety of 5.

Transportation of bridge material and the fact that it is almost impossible to secure experienced men to do field riveting on a small job in a new and isolated tropical country were vital factors in the further design. So it was specified that erection was to be completed by using bolts and nuts, the nuts to be locked after every member was in its final position.

Transportation Involved Four Railways and 7½-Mile Ox-Cart Haul

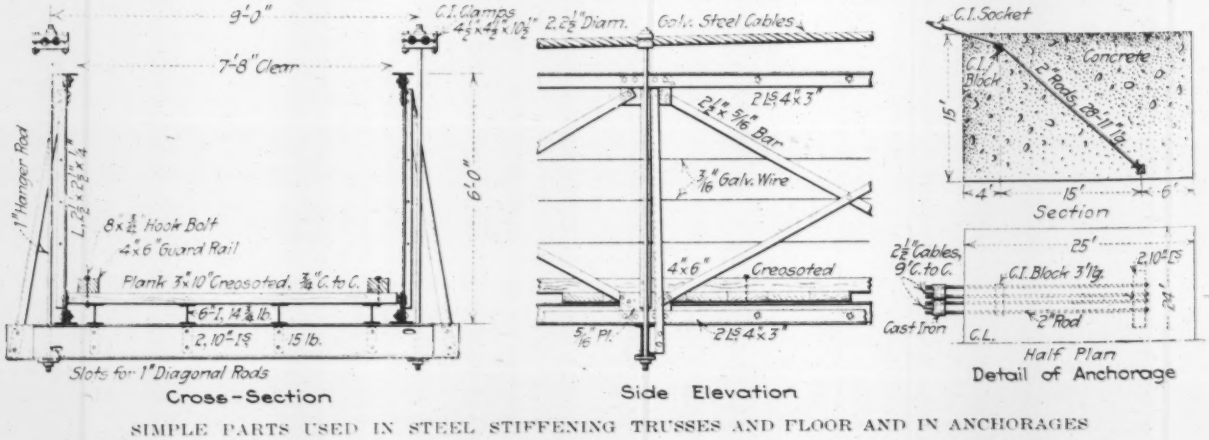
The steel was to be shipped from New York to Colon, 2000 miles, reloaded on Panama R.R. cars and taken across the Isthmus to dock at Panama City, reloaded on a barge or light passenger boat, shipped 325 miles up the Pacific Coast to the new railroad dock at Pedrigal, reloaded on flat-cars and hauled 4½ miles to David and finally loaded on two-wheel ox-carts and hauled over very bad roads 7½ miles to the bridge site.

The original plans were made by the writer and handed to R. W. Hebard & Co., the contractors for the construction of the Chiriqui Ry., with instructions to do the grading and all work pertaining to the completion of the bridge in connection with their railroad work. The plans were submitted to the American Bridge Co., whose engineers, while following the general plan as submitted, made a number of changes in the details. Big improvements over the original delays were made in the hanger-rod connections, the towers and the anchorages. In place of making the 8-in. H-section posts of the towers in one piece, 42 ft. long, they were made in two, with connecting plates riveted to one post, ready to bolt to the other during erection.

The most difficult transportation item was moving the four 2½-in. cables, each of which, with end sockets attached, weighed about 4½ tons, including the reel. To be able to haul the cable reels over the 7½ miles with safety, it was found necessary to strengthen the floor system of a 230-ft. suspension bridge, build several culverts and repair the wagon road. The trip was accomplished without serious incident, however.

Cables Pulled Across the River on ¾-Inch Temporary Cables

When the masonry was completed with anchorage rods in place, the steel towers were first erected. Then two ¾-in. steel cables were stretched over the towers, with ends fastened at the anchorages, to serve as carrier ropes for the permanent cables. One of the 4½-ton reels was now mounted in front of the anchorage, turning on a tem-



SIMPLE PARTS USED IN STEEL STIFFENING TRUSSES AND FLOOR AND IN ANCHORAGES

porary axle. The socket at the outer end of the cable was lifted by rope tackle to the top of the tower and then pulled across by hand windlass to the other anchorage on the ¾-in. cable with a 2-in. manila rope attached to casting and sheave. As soon as the socket was fastened to the opposite anchor rods, the socket at the reel was also connected to the anchor rods, and the cable was stretched to proper sag by tightening up the anchor-yoke nuts.

By the same process each cable of the four was put in place, and all were adjusted to the same sag, a little

FIELD CONNECTIONS ARE WITH BOLTS AND NUTS, AS MEN FOR FIELD RIVETING WERE SCARCE

above final position at center to allow for additional sag under the floor dead-load. The bridge was calculated to have a 3-ft. camber, but after receiving the full load it settled down to a 2½-ft. camber.

It is difficult to estimate exactly the dead-load sag in bridges of this kind. In erecting the 600-ft. suspension bridge across the Panama Canal in 1909, we got 2 ft. more sag than expected; yet the span retained sufficient camber to give it a fine appearance.

Lateral Stays

The towers are stayed laterally by ¾-in. steel guy cables, as the drawings indicate. The floor of the span has two ¾-in. guy cables on each side, well anchored into concrete. These side guys, together with the steel stiffening trusses and the continuous floor system (6-in. I-beam stringers well spliced, and 4 x 6-in. wooden guard-rails bolted and spliced) make the bridge almost rigid. Even in a strong wind, or with a heavy load passing over the bridge, there is very little vibration or oscillation.

Under conditions similar to those prevailing in the case described, I believe the suspension type of bridge is the easiest and quickest to erect, as well as the cheapest. For the next 30 years the Chiriqui bridge will answer all purposes for which it was built. The only cost for maintenance will be renewal of the wooden floor and repainting of the steel.

New Grading of Fire Resistance as Measured by Tests

Joint Committee Proposes That Time of Fire Resistance in Test Panels Replace Present Indefinite Gradings

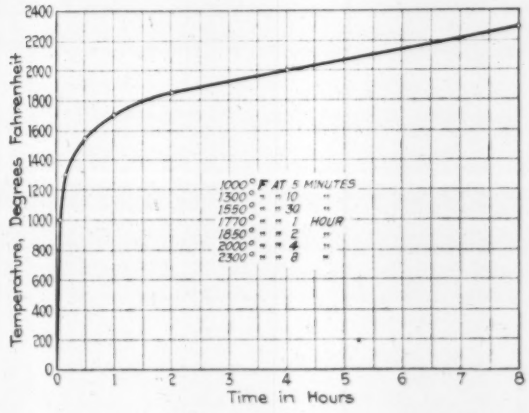
A JOINT committee, made up of representatives of the National Fire Protection Association, the American Society for Testing Materials, Bureau of Standards, National Board of Fire Underwriters, Underwriters Laboratories, Associated Factory Mutual Fire Insurance Co., American Society of Mechanical Engineers, American Society of Civil Engineers, Canadian Society of Civil Engineers, and American Concrete Institute, has been meeting during the past winter in the endeavor to standardize the methods of making fire tests of buildings. Much progress has been made, particularly along the line of classifying buildings according to their fire-resistive qualities as shown in large-size unit tests.

The first presentation of the work of the joint committee was made by one of the constituent committees, that on Fire Resistive Construction of the National Fire Protection Association, before the annual meeting of that association, held in Washington, May 8 to 10, 1917. Ira H. Woolson, of the National Board of Fire Underwriters, is chairman of the committee.

Three Objects Accomplished

The conferences between the various committees accomplished three important objects:

An agreement was reached that fire-resisting materials and construction should be classified in three or more grades, based upon the degree of protection which they would afford when measured by a fire test conducted in accordance with a standard time-temperature curve. For various reasons it was decided that the terms "Full,"



TIME-TEMPERATURE CURVE CLASSIFIES TYPES OF FIRE PROTECTION

"Partial," and "Temporary Protection," previously recommended, were unsatisfactory. In place of this plan to classify standards of fire resistance by groups, the conference decided to adopt the terms "Four-hour Protection," "Two-hour Protection," "One-hour Protection," etc.

There was adopted a tentative standard time-temperature curve to control the conduct of a fire test of materials and construction. The points on the curve which

determine its character were selected by the conference and are indicated on the plot of the curve shown on the preceding page. It was also decided that the temperature fixed by the curve shall be deemed to be the average temperature shown by the several thermocouples, not less than three distributed over the surface of the test sample and situated at distances of 6 in. from the surface of the test sample. This curve is subject to change following experimentation.

The committee further made some detailed recommendations as to times of tests on various members and materials, which will probably be subjected to close scrutiny in the meetings of the constituent societies when the respective committees present their reports.

Marked Advance in Treating Sewage from Packing Houses

Experimental Activated-Sludge Plant at Fort Worth, Tex., Is Equipped with Special Revolving Screen and Settling Tank

By G. B. ZIMMELE
Sanitary Engineer, Austin, Tex.; formerly with Milwaukee Sewerage Commission

ON AUG. 22, 1916, a small experimental activated-sludge plant was put into operation to treat the waste of the packing houses at Fort Worth, Tex. Due to the scarcity of water, these packing houses produce an exceedingly strong sewage and hence have a peculiar problem to solve. The sewage carries from 3000 to 3500 and occasionally up to 6000 parts per million of suspended matter. This is a much more highly concentrated waste than that produced at the Chicago packing houses. The volume of sewage is about 2,500,000 gal. per day and is nearly all produced between 8 a.m. and 5 p.m.

Formerly, the sewage was subjected to plain sedimentation, but the effluent was still highly putrescible and constituted a nuisance in polluting the Trinity River. With the passage of the McNealus Stream Pollution act several years ago, the problem of further purifying the sewage became acute. The success of the experiments with the activated-sludge process at Milwaukee and at the Armour establishment at Chicago led to the installation of this plant.

The design was prepared by G. B. Mulloy, who had gained his experience at the Chicago Armour plant. He skillfully reconstructed some of the old settling tanks to meet the new requirements. The operation has been under the direct supervision of Dr. W. C. Moor, chemist for Armour at Fort Worth.

The sketch shows roughly the general plan of the activated-sludge plant. The exceedingly compact nature of the design is evident. Electric power, water and air are supplied in abundance, and at this time unlimited opportunity is given to the carrying on of the tests.

Preliminary screening and settling of the sewage are necessary on account of the large amount and character of the suspended matter. The screen is Mr. Mulloy's own design. It is a horizontal cylinder of 30-mesh wire revolving about a 3-in. pipe. The sewage enters the screen through this pipe and is discharged into it at one end. The water passes through the screen immediately. There are blades that carry the sludge along horizontally and discharge it at the other end of the screen. The sur[face] is cleaned when necessary by a blast of air from a [row] of nozzles on the outside.

Kremer Tank Used

The screened sewage passes through a Kremer ta[nk] which is a patented tank designed and built by [the] National Sanitary Service Co., Chicago, Ill. It is [a] 6 x 6-ft. concrete tank, about 14 ft. deep, in which [are] suspended two square baffles. One baffle is about 6 [ft.] from the overflow weir and extends down to a dept[h] of about 4 ft.; the second is about 3 ft. square and exte[nds] down to a depth of 2 ft. The sewage enters the tan[k] inside the second baffle and strikes deflecting angle iron[s]. The theory is that the heavy material is deflected down[ward] and the lighter upward. The sludge is removed [by] siphonic action through a 2½-in. pipe. The water capac[ity] of the tank is approximately 1500 gal. and the sludge capacity 11 gal. The time required to fill is 25 minutes.

The aëration tank was reconstructed from an old settling tank. Each channel is about 8½ x 29 ft. in plan, with an average sewage depth of 9 ft. The slope of the bottom is one to one. Originally, the baffles did not extend all the way across the tank, so the sewage was given a zigzag course; they have been altered, however, so that now the sewage is forced to flow under and over them.

The sedimentation tank is 11 ft. square and 14 ft. deep. It has a hopper bottom and slopes of 8 vertical to 5 horizontal. The aërated sewage enters the center of the tank through a flaring pipe and discharges at a point about 8 ft. below the surface. The effluent overflows at the periphery of the tank, and the sludge is removed from the bottom through a 2-in. air lift.

Air-Diffusion Pipes Lifted To Clean Perforations

Measuring disks, manometer tubes, gages and valves have been placed on all air lines. A 1½-in. air line supplies four 3-in. distributing headers, from which ¾-in. down pipes tap off to the air-diffusing pipes. These latter are ¾-in. pipes perforated with about 1/25-in. holes, through which the air escapes freely.

These holes clog badly, especially when the air has to be shut off. The cost and the difficulty of removing and cleaning them have led to the substitution of ordinary rubber hose for the ¾-in. down pipes. When it is necessary to shut off the air or desirable to examine or to clean the diffusion pipes, it is merely a matter of drawing them up to the surface.

This feature is particularly noteworthy. Everywhere some difficulty has been experienced with the clogging of filtros plates and open air jets. The problem of cleaning them is a serious and an expensive proposition. The solution seems to have been found in the substitution of the rubber hose for the iron pipe.

Six Conclusions on Sludge

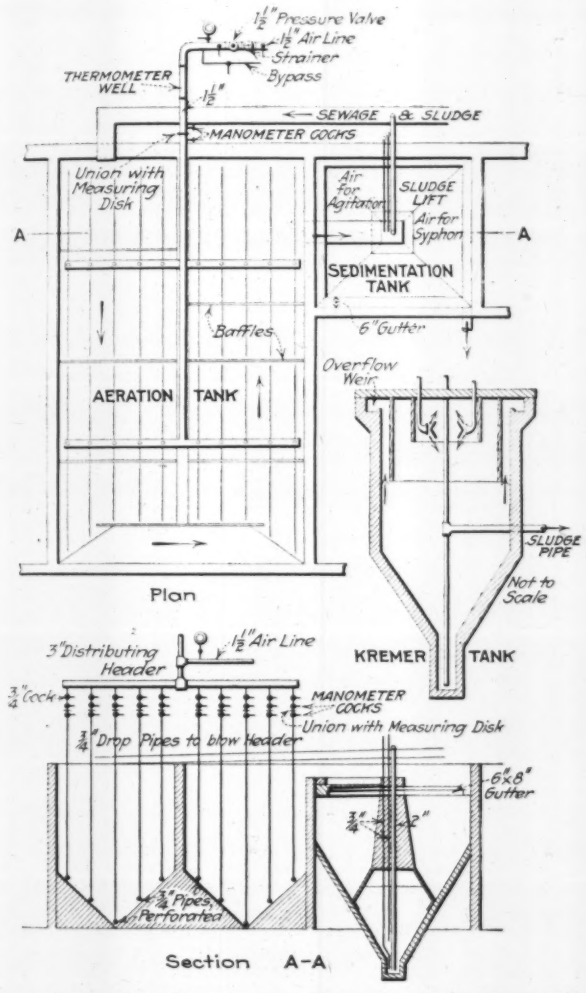
The operation of an experimental plant must necessarily be extremely varied. As there is practically no night flow of sewage, at first no effort was made to feed sewage to the plant at night; but aëration of the sewage in the tank was maintained. Lately, however, sewage has been stored during the day and then pumped to the plant at night, so that the operation has been con-

tinuous. They are now treating 20 gal. of screened and settled sewage per minute.

The period of aëration is now about 10 hours, with a period of sedimentation of 2 to 2½ hours. Six- and eight-hour aëration periods have also been tried. The sludge may be returned directly to the aëration tank, or it may be aërated separately for three- or four-hour periods and then pumped to the aëration tank.

Six conclusions, some of possibly far-reaching importance, have been reached as a result of these experiments:

1. It is necessary to screen and settle this sewage. By these preliminary processes the suspended matter is reduced from 3000 or 4000 to about 700 parts per million.



COMPACT EXPERIMENTAL ACTIVATED-SLUDGE PLANT FOR PACKING HOUSES, FORT WORTH, TEXAS

2. Even this sewage is too strong for ordinary treatment. It is necessary to dilute it either with water or with the treated effluent. From one to four parts of water to one part of sewage is required. Three or four parts of water seem to give the most satisfactory results.

3. The proportion of sludge has been varied, and a large percentage has been found more satisfactory than a small—35% is better than 25%.

4. The separate aëration of the sludge improves the entire process of purification.

5. The effluent is stable and so well purified that it is reused in the packing house like ordinary water. The stability runs over 90.

6. The problem of dewatering the sludge has been solved, at least for packing-house sludge, and the process patented. To the writer's mind this contribution is the most notable one that has been made to this process of sewage purification. Essentially, the process is one of acidification of the sludge with cheap, commercial sulphuric acid, which causes a coagulation of the albuminous substances. The action is assisted materially by the application of heat. At a temperature of 90 to 100° F. it is almost instantaneous, but at lower temperatures it is much slower. The whole mass of sludge rises quickly to the surface, and the clear water may be drawn off from beneath. By this treatment at Fort Worth, in the time that it takes to tell it, sludge containing 99% water may be dewatered to a content of 85%. The sludge of 85% water continues to give up its moisture on standing or drying, more readily than other sludge containing 85% water.

Sludge Value of Fertilizer Increased

Remarkable, too, are the analyses of this treated sludge. Whereas the untreated, 99% water sludge may run 6 to 8% of ammonia, the treated, 85% water sludge contains upward of 11%. This is undoubtedly due to the removal of inert solids in solution in the water drawn off.

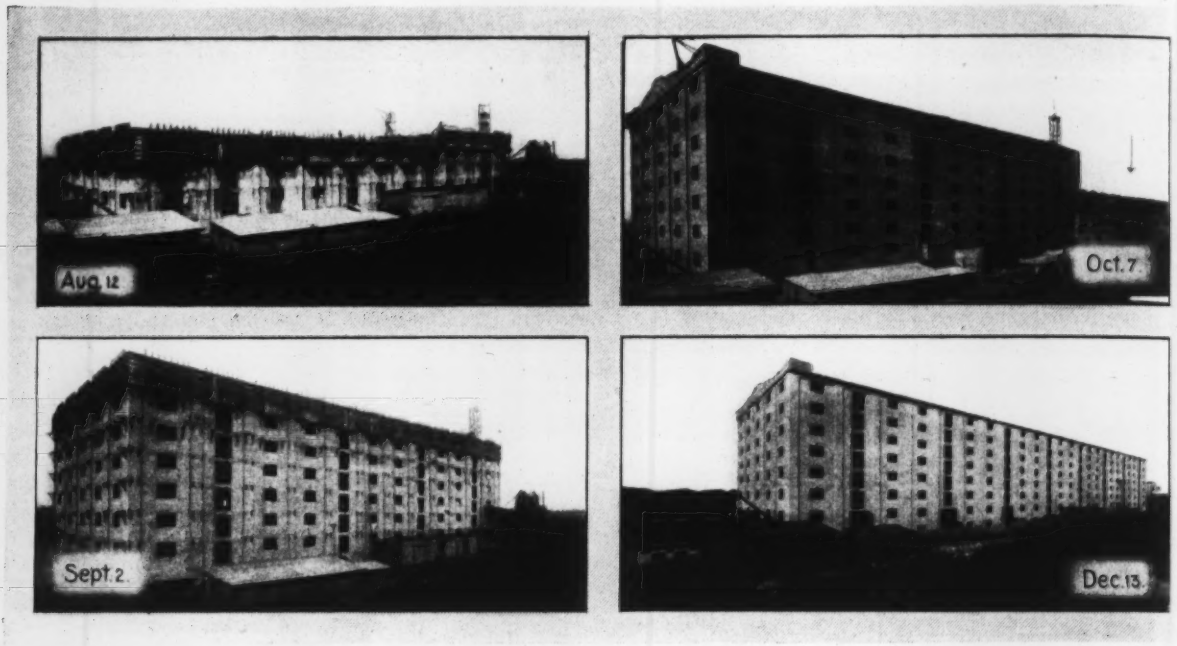
The value of the sludge as a fertilizer is increased. First, the addition of the acid holds the ammonia—contrary to the effect of adding lime. Second, the availability of the nitrogen is increased. By the neutral permanganate method, blood contains about 90% available nitrogen, but this treated sludge contains about 93½% available nitrogen.

It is evident that this packing-house sewage, the treatment of which has defied solution for years, can be successfully handled by the activated-sludge process. The greatest credit is due Dr. Moor for his solution of the difficult sludge problem.

V. M. Ehlers, state sanitary engineer, who has been watching the experiments with considerable interest, believes that this method of treatment will permit the packing houses to meet the requirements of the anti-stream pollution act. He has suggested that the City of Fort Worth and the packers coöperate in the work of constructing and of operating an activated-sludge plant to treat the combined flow of sewage from both sources.

Plan Big Dam

One of the great dams of the world is projected as a part of the Upper Murray Storage Project of the Water Conservation and Irrigation Commission of New South Wales. The report of that body for 1915-16 contains a few lines on the project, from which it appears that of 13 sites explored all but one showed the rock to be 200 ft. or more below the surface. At the date of the report (June 30, 1916) borings and surveys were being made of a possible site at the junction of the Mitta Mitta River with the Murray, and storage possibilities of a site near Juzellic were also being determined.



FIGS. 1 TO 4. EVERY WEEK A NEW STORY WAS ADDED TO THE BELLEVILLE REINFORCED-CONCRETE WAREHOUSE

One Story of Reinforced-Concrete Building, Half Acre in Area, Built Every Five Days

Large Cotton Warehouse, Eight Stories High, Built in Two Parts, Each 240 x 100 Ft. in Plan—Construction Takes Eighty Working Days

ONE COMPLETE story—including walls, floors and window frames—finished every week for 16 weeks was the record made on the new reinforced-concrete cotton warehouse for the Belleville Warehouse Co., at New Bedford, Mass., by the Turner Construction Co., in the summer and fall of 1916. This meant that 112 calendar days elapsed between the setting up of the forms for the first story and the placing of the last of the roof concrete. Deducting Sundays, holidays and days lost on account of rain, etc., the actual working days were 80, so that 5 days were devoted to each of the 16 stories.

The building is eight stories high and 482 x 100 ft. in plan. On account of the desire of the owner to put it into service for storage of cotton as soon as possible, it was decided to build it in two sections, each about 100 x 240 ft. in plan, and to put the first eight-story section to work while the second was under way. Thus 16 stories, each over one-half acre in extent, had to be built.

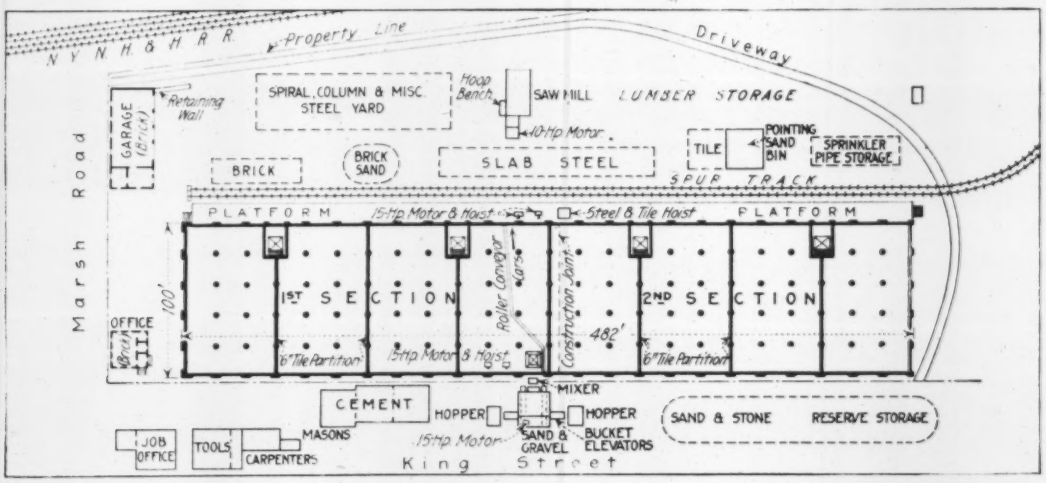


FIG. 5. HOW THE CONSTRUCTION PLANT WAS LAID OUT AT THE BELLEVILLE SITE

The building is of the flat-slab type, with 20 x 20-ft. panels and 8-ft. story height, a vertical spacing that with girderless construction permits storing of cotton bales with just proper clearance for sprinklers. The walls are of solid concrete placed along with the supporting structure, and there are separate interior partitions of clay tile every three longitudinal bays. Steel window frames were put in along with the concrete.

One Set of Story Forms Used Throughout

Only one set of forms was built for the half-building. This one set was used approximately 16 times. On July 15 the forms were completed and erected for the first self supporting floor of the first section. On Sept. 2 the roof of that section was completed. These forms were then removed from the roof of the first section and erected for the first self-supporting floor of the second section, and on Nov. 4 the roof of the second section was completely placed. To finish an average floor in five days it was necessary to place 750 yd. of concrete, using 4000 bags of cement, 350 yd. of sand and 700 yd. of stone, to hoist and place 30 tons of steel reinforcement and to lay and finish 24,100 sq.ft. of granolithic floor.

The layout for the construction is shown in Fig. 5. As will be seen there, the building is approached by main-line railway tracks, alongside of which was located the storage yard for steel, brick and lumber. On the opposite side of the building was placed the concreting plant. All steel, brick, lumber and cement were brought in over the railway track and stored, except the cement, in the yard on that side. The cement was brought up to the building site and transported across the building on a roller con-

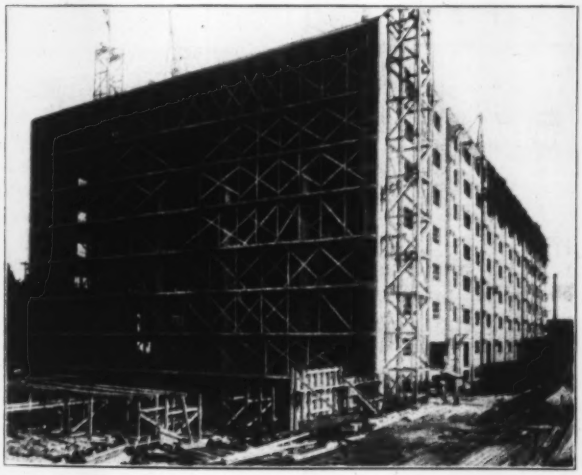


FIG. 6. THE JOINTS BETWEEN THE FIRST AND SECOND SECTIONS. NOTICE THAT BREAK IS IN FLOOR JUST OUTSIDE COLUMN HEAD

veyor to the mixing plant. Sand and stone were brought in by motor trucks and dumped directly into the mixer storage. The sand and gravel were brought to New Bedford by boat, lifted from the boat to supply piles by clam-shells and from supply piles to motor trucks by special loaders. Fig. 7 shows two of the trucks delivering to the plant. Concrete was mixed and dumped to the elevator and carried to the proper place on the job in buggies.

The speed schedule, which was laid out before the construction of the building, was adhered to by careful attention to detail, in spite of the shortage of labor and congestion of railroads which existed at the time. The job was manned by a construction organization transferred from a recently completed building similar to the one under way. This organization included not only a superintendent and the various foremen, but also a large number of carpenters and concrete laborers who had had a year's experience doing that particular line of work in the continuous employ of the contractor. The planning of the work was facilitated and expedited by department meetings held each week, conducted by an executive official with a representative of each department present.

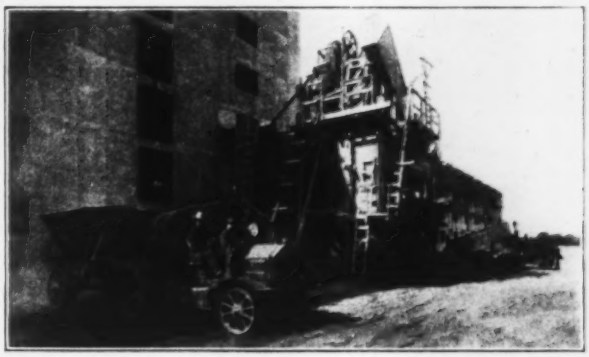


FIG. 7. BRINGING IN THE SAND AND GRAVEL TO THE MIXER PLANT ON THE BELLEVILLE WAREHOUSE JOB

At these meetings every item of labor and material entering into the building was taken up. Minutes were kept and distributed, and definite responsibilities were delegated to the various department representatives.

The warehouse was especially designed for cotton storage. The railway side is provided with a siding and a shipping platform upon which the cotton can be directly dumped and easily transported to elevators that serve all the floors. On the opposite side of the building are truck-high shipping platforms for use in delivering the cotton to the mills by trucks. The building will serve a number of mills in New Bedford. It was built under plans prepared by C. R. Makepeace & Co., of Providence, R. I.

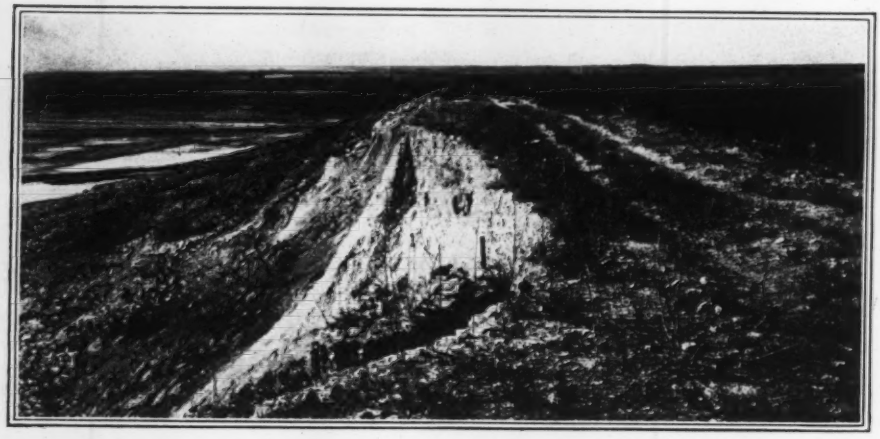
Irrigation Company Gives Automobile Costs

During the past six years the Imperial Water Co. No. 1, Imperial, Calif., has used eight automobiles, which have traveled 172,105 miles. Costs on five of these automobiles are given in the last annual report of the company, as follows:

	Overland 1914	Buick 1914	Cadillac 1915	Ford 1916	Hupp 1916
Purchase price	$1,225	$1,060	$2,125	$560 30	$1,295
Miles run	34,477	37,403	24,000	6,252	2,938
Gasoline, gals	2,965	2,526	2,286	368	254
Total repairs	$1,399 14	$1,019 05	$440 24	$43 05	$2 67
Total operating cost	$2,266 96	$1,675 45	$1,064 22	$164 46	$84 76
Operating cost, mile	$0 0659	$0 0447	$0 0443	$0 0263	$0 0288
Total expense	$3,833 20	$2,712 31	$2,607 46	$3,378 44	$208 08
Total cost, mile	$0 1112	$0 0725	$0 1086	$0 0605	$0 0708
Average miles per gallon of gasoline	11 63	14 81	10 49	17 00	11 57
Average cost per mile of casings	$0 0146	$0 0094	$0 0176	$0 0096	$0 097
Depreciation on car per mile	$0 0297	$0 0203	$0 0369	$0 0256	$0 0323

All four of the company cars are still in use and are valued as follows: Overland, $200; Cadillac, $1000; Ford, $400; Hupp, $1200.

The Case of the Standley Lake Dam



Two Engineers Tell How Material on Faces of Earth Structure Slipped Twice in Six Years

Twice during the six years since its completion, the Standley Lake Dam, a large irrigation earth dam built in 1908-12, about nine miles north of Denver, Colo., has developed pronounced slippage; in 1914, on the outer or downstream face, in 1916 on the inner or upstream face. The later conditions seem to be quite serious in prospect of future movements if not in the immediate safety of the dam and have aroused widespread interest among engineers of the Rocky Mountain district. At recent meetings of the Colorado Association of Members of the American Society of Civil Engineers the subject was discussed in some detail, following the presentation of a paper on the dam by John E. Hayes, Chief Engineer of the Farmers Reservoir and Irrigation Co., of Denver, which now controls the dam. Mr. Hayes' company did not take over the dam until near its completion and his knowledge of its early history is based on records. He has been, however, intimately connected with it in recent years and can give first-hand authoritative views and testimony of the later conditions.

In this article there is given an extended abstract of Mr. Hayes' paper, followed by a portion of the discussion by A. L. Fellows, a Denver engineer, who has investigated and examined the dam since its latest slip. The drawings herewith are from Mr. Hayes' records; the views were furnished by Mr. Fellows.

How Standley Lake Dam Was Built and the Story of the Slips

By JOHN E. HAYES
Chief Engineer, Farmers Reservoir and Irrigation Co., Denver, Colo.

STANDLEY LAKE is one of the four large reservoirs of The Farmers Reservoir and Irrigation Co.'s System, a system comprising 30 reservoirs and 463 miles of main canals. There are in Standley Dam 3¼ million cubic yards of material and, as constructed, its dimensions are: Length on top, 6630 ft.; maximum height, 113 ft.; crown width, 20 ft.; inside slopes, 3 to 1 and 2 to 1; outside slope, 2 to 1.

The first plans for the dam were made by J. G. White & Co., of New York City. This design called for an earth dam, approximately 2 miles in length, 143 ft. in height, with an inside slope of 3 to 1 and an outside slope of 2 to 1. A concrete core wall was to extend through the dam. In the fall of 1907 the White company's connection with the work ceased. At that time a portion of the base of the dam had been stripped and a construction camp erected. Thereafter, George M. Bull, Resident Engineer for J. G. White & Co., continued to fill the position of Chief Engineer for the project and James D. Schuyler was retained as Consulting Engineer. It was his opinion that the dam could best be constructed by sluicing in the material and a new set of plans was prepared with this in view. Wash drill borings revealed foundation conditions as shown in the section in Fig. 2.

Early Work on Heel and Toe Embankments

In the early summer of 1908 a team outfit began stripping the base of the dam and constructing dikes along each toe from Sta. 26 to 40. Earth was to have been sluiced in between the dikes. In September, 1908, a standard-gage railroad spur was constructed from the Colorado and Southern main line to the construction camp, a distance of more than a mile.

Another change in engineering occurred in November, 1908, when the Arnold Co., Engineers, of Chicago, with W. H. Rosecrans, Chief Engineer, took charge and the dam was constructed according to plans and specifications prepared by them.

After the foundation had been prepared, a system of tile wells and drains was placed near the toe of the outer fill at intervals of 100 ft., between Sta. 23 and 47. The wells consist of 24- and 30-in. vitrified tile, surrounded on the sides and bottom with one foot of sand and gravel. The covers for the wells are reinforced-concrete slabs, 6x6 ft. by 6 in. thick. A line of 4-in. sewer pipe was laid from each well to the toe of the embankment, the wells also being connected each with the other by lines of 4-in. tile.

Wakefield and steel sheet piling was driven along the center line of the dam from Sta. 26 + 50 to Sta. 45 + 69.

for the purpose of cutting off seepage through the sand and gravel material. Twelve and sixteen-foot piling was used, the penetration averaging about 12 ft., except at the ends, where it was stepped to 6 ft.

A cut-off trench was excavated from each end of the sheet piling along the axis of the dam, as shown in Fig. 2. These trenches averaged 4 ft. in depth, with a bottom width of 6 ft. and side slopes of 1 to 1. An auxiliary trench was dug 30 ft. west of and parallel to the center line, from Sta. 22 to 24 + 50. These trenches were back-filled and wet puddled during the placing of the earth fill.

The dikes along the toes from Sta. 26 to 40, which were under construction when the Arnold Co. took charge, were incorporated in the new design. The puddle core area, as designed, having a 70-ft. base width at El. 5400 and a 10-ft. top width at El. 5513, is indicated upon Fig. 2.

An outlet conduit was provided consisting of four lines of 48-in. cast-iron pipe, placed side by side, the pipe resting upon a slab of concrete 18 in. thick and embedded in concrete to a depth of 24 in. or up to their horizontal diameter.

Lower Embankment Dumped from Wagons and Cars

The contract for the construction of the dam was awarded to the Kenefick-Quigley-Russell Construction Co. on Nov. 16, 1908, with a stipulation that the dam be completed to the 70-ft. elevation by March, 1910, and to the 113-ft. height by November, 1910. The contractors began placing their equipment at once and had the full plant in operation in February, 1909.

From Sta. 2 + 62, to Sta. 22, and from Sta. 58 to 69, the embankment was placed with teams and dump wagons, the puddle core having been carried up from the base through the fill by means of an open ditch along the center line. Water entering the ditch was distributed in such manner that the required amount necessary for puddling was obtained. The usual method was to check the water by small cross dams, allowing it to stand for a period of time, then cover the wetted surface with earth and compact the same by team and wagon travel.

Between Sta. 22 and 58 the material was loaded with steam shovels and transported to the fill by standard-gage trains, consisting of a steam locomotive and ten 12-yd. dump cars.

The dikes along the toes were built to a height of 30 ft., with 20-ft. crowns. Tracks were laid along their tops and by shifting and dumping toward the center of the dam the 30-ft. lift was carried forward.

Water Impounded Between Fills

Water was impounded between the fills, allowing the earth to become saturated as it was dumped therein, thus the puddle core was being formed. It was found that the material—a rather lumpy, hard, blue clay—slacked very readily when brought in contact with water.

The design for the puddle core shows that in the center of the dam a section, 10 ft. wide at the top and 70 ft. wide at the base, was to be formed by dumping into a pond of water.

Work had progressed for approximately a month when the contractors, wishing to avail themselves of every facility for rushing the work, asked that they be permitted to close the 30-ft. lift at about Sta. 28, thus permitting trains to operate from the southwest borrow pit. There is no record of this part of the fill having been puddled.

About May 19, 1909, when water was admitted between the dikes, the pond was raised to an elevation of 23½ ft. above the lowest point of the dam, extending from Sta. 30 to 46, although over a considerable portion the dikes had not yet reached the puddle core limits, as they had not been kept parallel to each other. The height of the pond was governed by the narrowest width of the core space across the pool. Between Sta. 40 and 46 the pond was much wider than required. An outlet through the west dike at the 23½-ft. elevation allowed the water not taken up by the earth to spill into the reservoir basin.

Placing Upper Lifts from Trestle Fills

From Sta. 22 to 58 the upper lift was placed by dumping from trestles, following the scheme detailed in Fig. 5. As soon as the dikes on the 30 elevation had been widened

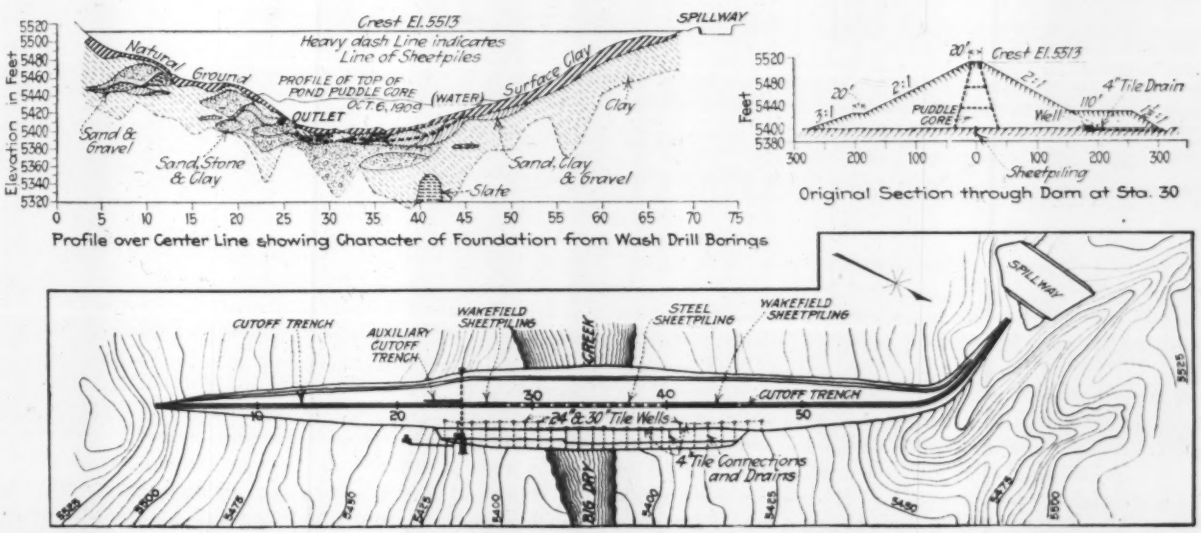


FIG. 2. STANDLEY LAKE DAM AS BUILT AND FORMATION OF STRATA UNDER THE DAM

sufficiently toward the center of the dam, two lines of timber trestle, 40 ft. in height, were constructed, each carrying a single track. These trestles ran from Sta. 22 to 51 and were so placed that the outside top edge of each at the 70 elevation fell just inside the neat lines of the dam. The fill was placed rapidly and upon reaching the tops of these trestles the plan was to fill in between by shifting the tracks and dumping toward the center, keeping the fills parallel and maintaining a pond of water the width of the puddle core.

This method of forming the puddle core was followed until its top reached approximately the 30 elevation. The plan was to continue this method of construction, but before it was put into execution, a timbered test hole was dug on the axis of the dam at about Sta. 33, extending down through the 30-ft. lift. When the level was reached at which water had been standing in the lower pool, it was found that the material had become a thin, slimy ooze, with no stability whatever. The hard, blue clay placed three or four months previous was supersaturated. Several test holes were bored in the 30-ft. lift with an auger and it was the opinion of the resident engineers that 13% was the proper amount of moisture to produce the required homogeneous mass. The experiments showed that when the moisture exceeded this percentage the hole would close upon removal of the auger. Further, it was found that when the moisture ran as high as 18% in the material as it came from the borrow pits, the lumps of clay were softened and compacted by natural settlement to a consistency apparently as soft as the material containing the 13% added moisture. Due to these investigations and conclusions, the method of constructing the puddle core was changed and the profile taken Oct. 6, 1909, Fig. 2, indicates the top of the pond method puddle.

Thereafter, up to 64 elevation, material was scattered in thin layers with teams and slips, over the puddle core area, sprinkled by means of hose and compacted by the team travel.

When the puddle core had reached the 64 elevation, the teams were removed and the balance filled in with the trains. It was the opinion then, that the heavy trains running back and forth over the 6-ft. lift would compact the mass as well as teams and slips.

Trestle Settles Five Feet

After having reached the top of the 70 elevation, it was found, in several places along the west side of this lift, that the trestle and embankment had settled to about the 65 elevation. A lift sufficient to bring the top of the fill to the 70 elevation was made by jacking and shifting the track. This lift was gradually increased to a height of from 15 to 17 ft.

In placing the top lift, from Sta. 18 to 58, a single line of timber trestle was constructed, with the top elevation at 110 ft. The trestle was placed to the right of the center line, that it might not interfere with the core construction. For that part of this trestle (Sta. 25 to 40) a 20-ft. fill was made, thereby decreasing the height of the timber structure.

After having reached the top of the trestle, the dam was topped off by jacking and shifting the track. For this last lift there are very few data on the puddle core construction.

Rapid progress was made until June 6, 1910, at which time the appointment of a Receiver caused a suspension of the work. On that date the embankment was practically complete, there remaining approximately 200,000 cu.yd. of earth to be placed along the top from Sta. 5 to 60. On Mar. 18, 1911, operations were again resumed

FIG. 3. FIRST EARTHWORK WAS TWO TOE FILLS MADE CLEAR ACROSS DAM

FIG. 4. ON TOP OF THE LOWER LEVEL FILL TOP FILL WAS DUMPED FROM WOOD TRESTLES

and the remaining top fill was placed, completing the earthwork in June, 1911.

Shortly after the appointment of the Receiver in June, 1910, the Arnold Co.'s engineers terminated their connection with the project. Upon resumption of operation in March, 1911, the writer became Chief Engineer for the Receiver, completing all unfinished work on the project, and since the completion of the construction has had charge of the maintenance and operation system.

Rock Riprap Instead of Concrete Facing

On account of the noticeable shrinkage, it was suggested that a rock riprap would undoubtedly remain in place and last longer than the proposed concrete slab facing. The State Engineer concurred in this opinion. After investigation the rock riprap was adopted. The plans called for a hand-laid riprap. This method was later changed for a dumped rock riprap, to be not less than 2 ft. in depth. The rock was dumped from the tracks, which had been left in place, one on a small berm at the 70 elevation and the other at the top of the dam. Where a 2-ft. depth had not been obtained by dumping, the rock was to be shifted by hand. As a result, the face of Standley Dam was covered with rock, varying in depth from 2 to 5 ft. This was completed in May, 1912.

During the course of construction, water was impounded in the reservoir basin to a depth of approximately 24 ft., reaching the fill from Sta. 26 to 45.

The following depths at which water has been impounded are from office records:

Year	Depth, Ft.	Year	Depth, Ft.
1910	25	1914	82
1911	30	1915	76
1912	82	1916	78
1913	83		

Fig. 6 gives a profile of the center line of Standley Dam, together with a profile of the crest on various dates, showing the shrinkage between the given dates. Profiles were taken in May, 1910, when work ceased, in March, 1911, just prior to the resumption of work and in June, 1911, when the earthwork was completed.

In May, 1912, upon completing the rock riprap, the top of the dam was slightly above grade, because of waste spalls and fine material hauled in with the rock. The profile of August, 1914, taken after the slip between Sta. 22 and 24, shows a marked shrinkage in the two years—May, 1912, to August, 1914.

Early in 1913, six months after the last work was performed, cracks appeared on the crown, running parallel with the center line, gradually opening until in the summer of 1914 they were over a foot in width, extending in some cases for 300 or 400 ft. The cracks appeared only in that portion of the dam constructed by trestle dump. At the inside edge of the crown settlement was quite pronounced in some places. Cross-sections taken in August, 1914, show a difference in elevation of 5 ft. between the inside and outside edges of the crown.

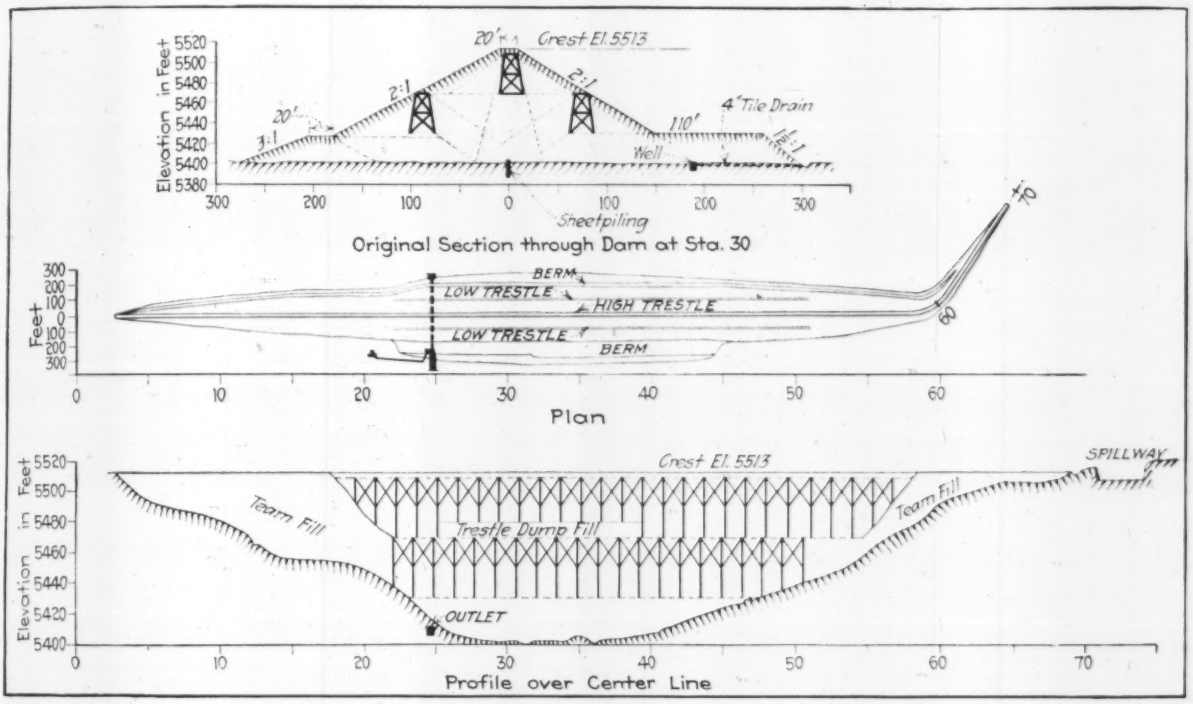


FIG. 5. HOW THE FILLING TRESTLES WERE PLACED IN THE DAM

Small Slip in 1912

Late in 1912 a small slip occurred on the outer slope, at Sta. 47, affecting an area of approximately 60 x 60 ft. between the 30 and 60 elevations. The area covered by this slip was slightly wet along the line of cleavage.

Aside from the natural settlement, the open cracks at the crown and the small slip at Sta. 47, no further visible disturbance occurred until July 29, 1914, when the area bounded by the center line of the dam and the toe of the outside slope, lying between Sta. 20 and 24, moved down and out, as shown in Fig. 6. The vertical drop at the crown was 15 ft. and the horizontal movement at the toe 60 ft. The entire mass was fissured. A well defined sliding plane was developed.

Measurements of the water entering a shaft sunk at Sta. 22 + 10 were made. During a 42-hr. period 48

cu.ft. of water entered. The water came in at the northeast corner of the shaft or the side farthest from the reservoir, between El. 5452 and 5449, no water having entered above or below these points. The reservoir gage on July 29, 1914, was 75 ft. or El. 5481.

After a careful examination, it was decided that no immediate danger threatened and that the slip was confined to the outside slope. In making repairs, 6-in. tile drains were placed under the base of the proposed berm, for the purpose of carrying off any seepage or ground water. A berm was constructed along the toe of the affected portion of such proportions as to counterbalance the weight of the material placed on the slope and top of the dam.

During the period in which repairs were being made, there were times when the mass was so evenly balanced that material placed in a half day on the top, caused a resumption of the movement and the same was stopped by a like quantity of material placed upon the preliminary berm. After noting this first movement, as an experiment the mass was started and stopped three times by the above means. Afterward sufficient material was placed in the final berm to effectually counterbalance and stop the slip. The work was completed in April, 1915, and to date no further movement has taken place on the outside slope.

[Out of 21, tell-tale well driven into the outer slope in August, 1914, water showed in nine. Out of these water showed to any extent only in two when examined in February, 1917. Those showing water were scattered among the dry wells.—Editor.]

Upstream Face Sloughs Off in 1916

On July 12, 1916, a small crack appeared upon the inside slope of the dam at El. 5480. This crack marked the visible beginning of what has developed into a general downward and outward movement of a portion of the inside slope material, extending from Sta. 22 + 50 to 46, as shown in Fig. 6. Water was being drawn off for irrigation purposes. The reservoir gage read 40 ft. on July 12, 1916, the rate of recession having been from 0.3 to 0.8 ft. per day.

The movement was quite rapid during the first week, both vertically and horizontally. On July 12, the first noticeable crack extended from Sta. 32 to 38, 5480, practically parallel to the center line from Sta. 33 + 50 to 38. From Sta. 33 + 50 back to Sta. 32 the crack curved toward the reservoir, intersecting the water surface opposite Sta. 32.

On July 13, twenty-four hours later, where this crack had been a nearly vertical shear, 10 ft. in height, existed and a crack similar to the original at Sta. 32 to 38 extended from Sta. 32 at El. 5480 back to Sta. 26 and forward from Sta. 38 to Sta. 46. Likewise the nearly vertical face along the line of the original crack was not less than 10 ft. in height and at this depth the earth was dry, with no evidence of its having been saturated.

Later, and after further movement, which increased the height of the vertical face, there appeared opposite Sta. 32 + 35 a pronounced seepage at El. 5450. Water

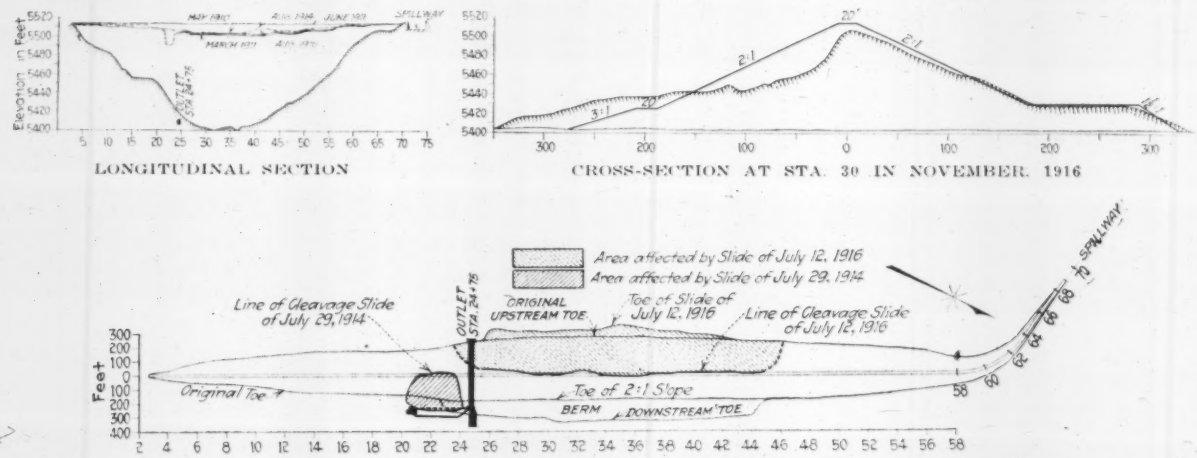


FIG. 6. IN 1914 AND AGAIN IN 1916 THE FACES OF THE DAM SLIPPED

After the movement had progressed to such an extent that a nearly vertical earth face some 20 to 30 ft. in height, extended along the line of original cracks, large wedge-shaped slabs of earth, varying in thickness from 5 to 10 ft. and 20 to 60 ft. in length, broke off and slid, point downward, following along the original sliding plane. The upper portion of the sliding plane has been visible several times. These masses did not turn over as a man falling forward, but remained top up, facing back at about 90° to the line of the plane. The general mass has assumed slopes varying from 3 to 1 to 5 to 1, the general broken surface emulating waves from 3 to 6 ft. high. Thousands of yards of the heavy rock riprap disappeared in the cracks.

A line of stakes 145 ft. from and parallel to the center line shows a maximum horizontal movement of 38 ft. from Aug. 4 to Nov. 3, 1916.

In Fig. 6 is shown the original section on the dam in full lines and the flattened inside slope as they were on Nov. 3, 1916. Sta. 30 is typical, although at some points the cleavage extends to the right of the center line. The line of cleavage on Nov. 3 is indicated as is the horizontal movement at the toe. The entire moving mass is fissured and the resistance at the toe is causing buckling. The cross-sections of Nov. 3, 1916, show that approximately 88,000 cu.yd. of material has been displaced, aside from the loss of the riprap.

One Engineer's Opinion as to Why the Standley Lake Dam Sloughed

By A. LINCOLN FELLOWS
Consulting Engineer, Denver, Colo.

WHAT has followed since the completion of the Standley Lake Dam might be easily guessed, and, in fact, was forecast by some engineers who visited the dam during the period of construction. Although no provision was made for settlement, the dam actually settled about 12% of its height, and it may be noted that this was to an elevation 8 ft. below the constructed spillway, making it theoretically possible (assuming that the dam could stand that loss without erosion) for 8 ft. of water to flow over the center of the dam before any water would flow out of the spillway. It is to be noted, also, that the original spillway elevation allowed for only a 5-ft. freeboard, assuming no settlement whatsoever in the embankment. In actual practice it has usually been found that from 12 to 15 ft. of freeboard in such reservoirs is the smallest amount that should be allowed after settlement.

The sloughing disclosed the fact that the trestles were largely decayed, although more or less solid timbers are still found, as would naturally be expected after a lapse of only seven years. It appears to the writer, however, that the existence of trestles in the dam, although undoubtedly largely a factor in the great settlement, was not primarily the factor mainly responsible for the sloughing of the dam. The general plan of construction as carried out seems as though devised for the purpose of eventually causing such sloughing of the face as has actually occurred.

FIG. 7. UPSTREAM FACE PILED UP IN 1916

There were, first, two solidly and compactly constructed embankments, between which, along the center of the embankment, was a pool of water which was never drained. The earthy material constituting the bulk of the embankment was loosely deposited by dumping, without tamping, rolling or any other kind of compacting. It, according to the testimony of witnesses, was largely of a lumpy and blocky character, sometimes frozen. Along the sides of the loblolly thus created was constructed dry embankments which prevented the inner section from drying out, so that this mucky condition appears, from evidence upon the ground, to have continued up to the time of the sloughing.

In December, 1913, occurred the greatest snowstorm known in history in the region, the ground being covered with snow to a depth of approximately 4 ft., and the ground surface everywhere was thoroughly saturated by the melting snow in the spring, no freezing of the ground occurring during the winter of 1913 and 1914. The surfaces of the embankment were thoroughly saturated, and a portion of the downstream face slid on its loblolly foundation. The upstream face at this time was, however, partially supported by the pressure of the water, which, as previously stated, reached at this time a depth of about 84 ft. against the face of the dam. Probably, also, the weight of the rock riprapping of the upstream face was of some assistance in holding this side in position. Through wave action, however, this riprapping was gradually displaced and settled to a considerable extent, weakening the upstream side, and during the summer of 1916 the water in the reservoir was for the most part drawn off rather rapidly for irrigation purposes, leaving a saturated surface with a slope of a little less than 2 horizontal to 1 vertical, which was of insufficient weight and strength to hold the upstream side in place, with the inevitable result that the section of the dam shown slipped out in a succession of great slides, being forced up onto the toe embankments, which, apparently, have never moved.

FIG. 8. THE 1916 SLIP SHOWS A SHEER FACE

The amount of material required to merely fill the vacancy left by the slip is said to be approximately 80,000 cu.yd.; this, however, does not indicate to any considerable extent the amount of work to be done in completely repairing the dam. The original cost of the dam was approximately $850,000 for embankment work, and $150,000 for riprapping, making the cost of the dam, exclusive of conduit, valves, etc., approximately a million dollars. What the total cost will be when reconstructed so as to hold water, no one can forecast.

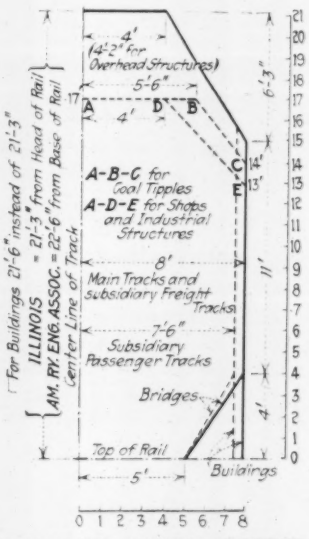
Illinois Establishes Railway Clearance Limits

Figures of Utilities Commission Slightly Exceed Those Adopted by Railway Engineering Association

MINIMUM clearances as established recently by the Illinois Public Utilities Commission differ but slightly from the standard clearance limits adopted by the American Railway Engineering Association. The most important difference is that the former requires a lateral clearance of 8 ft. instead of 7 ft. 6 in. from center of main track, and measures the vertical distances from the head instead of base of rail. The clearances for different classes of structures are shown in the accompanying diagram, plotted from the dimensions specified by the commission.

Track Centers

The minimum distance between centers of tracks is to be 13 ft. for main tracks used exclusively for passenger service, 13½ ft. where freight trains use one or both tracks, 15 ft. between a main track and adjacent subsidiary track, 15 and 17 ft. between a main track and a ladder track in which the switches are operated mechanically and by hand respectively, and 17 and 19 ft. between parallel ladder tracks having switches operated as above.



CLEARANCE LIMITS ADOPTED BY ILLINOIS COMMISSION

High freight platforms must be from 5 ft. 6 in. to 5 ft. 9 in. from edge of platform to center of track. Passenger platforms level with the car floors may have less than 8 ft. clearance where the tracks are used exclusively for passenger service and the cars have platform gates which are kept closed when trains are in motion. Passenger platforms not over 8 in. and 4 in. above top of rail must have a clearance of at least 5 ft. 1 in. and 4 ft. 6 in. respectively, from center of track.

Switchstands from 2 ft. 10 in. to 4 ft. high must be at least 8 ft. from the center line of a main track. 7½ ft. for a subsidiary freight track, or 7 ft. for a subsidiary passenger track. For switchstands more than 4 ft. high these clearances are 8 ft. 3 in., 8 ft. and 7 ft. 6 in. respectively. Signal posts must be at least 8 ft. 6 in. from center line of main tracks.

Water Cranes and Tanks

Water cranes or penstocks must have a clearance of 8 ft. 3 in. from center line of main track or passing track, or 8 ft. and 7½ ft. for subsidiary freight and passenger tracks respectively. At water tanks the clearance must be at least 9 ft. to a height of 15 ft. above the rail. The same clearance is required at whistle posts, crossing gates, signal bridges, etc. Fences between tracks at passenger stations (for tracks used primarily for passenger service) must be not higher than 4½ ft. above base of rail. Building material and supplies must not be piled within 9 ft. from center of a main track or 8½ ft. from center of any other track.

The side clearances as specified are for straight tracks. On curves compensation must be provided to maintain the minimum clearance.

Geared-Up Gas Engines Drive Clarksburg's New Pumps

West Virginia Water-Works Uses Gas-Engine-Driven Centrifugals To Conserve City's Fuel Supply

FORMERLY, water was supplied in Clarksburg, W. Va., by engine-driven centrifugal low-service pumps and duplex direct-acting high-service pumps, both taking steam from gas-fired boilers. When additional capacity was required, the City Water and Sewerage Board and its consulting engineer, George W. Fuller, of New York City, decided to use pumps driven by gas engines, in view of the rapid depletion of the natural-gas supply of the district and the necessity of making the city's fuel wells last as long as possible. The preliminary estimates showed that the gas-engine units would demand only about a third of the fuel needed for the boilers and steam machines.

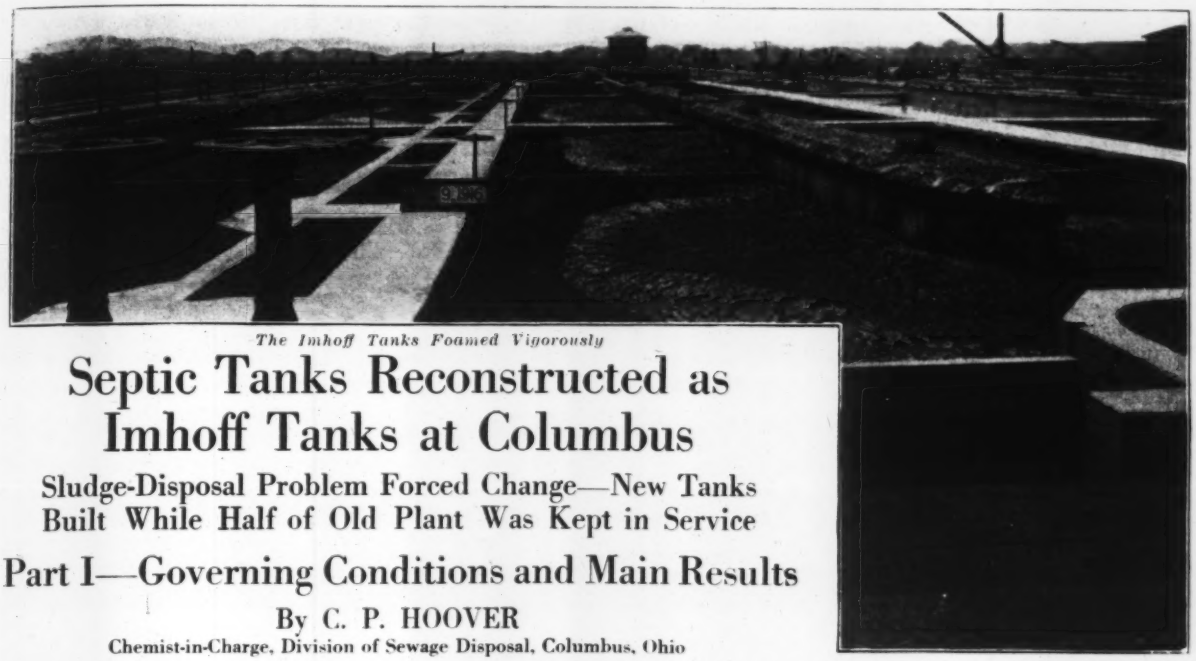
The equipment secured after bidding comprised a 4,000,000-gal. centrifugal pump, for 35-ft. head, driven by a 50-hp. engine, and a 4,000,000-gal. pump, for 350-ft. head, driven by a 350-hp. engine. Both pumps were made by the DeLaval Steam Turbine Co., of Trenton, N. J., and both gas engines by the Bruce McBeth Engine Co., of Cleveland. The small unit supplies the filter beds, and the larger one pumps into the city reservoir. The engine speed is stepped up by double helical gears from 200 r.p.m. to 1385.

During a 10-day continuous run the total gas consumption of both units averaged 82,200 cu.ft. of gas per day; the delivery was held up to 4,100,000 gal. per day against 330- and 30-ft. heads, giving a load of 258.5 water horsepower. The gas comes from the city's wells and is charged up at 6c. per 1000 cu.ft., although the local commercial power rate is 8c. At 6c. the fuel costs $6.96 per hp. per year, or 0.079c. per hp.-hr.

The complete cost of pumping equipment is reported to have been approximately $17,500; the substructures, superstructure, crane, piping and appurtenances cost complete $13,905, bringing the total to $31,405. The interest, depreciation and upkeep, figured at 10% (equivalent to 12% on machinery and 8% on structures), would be $3140, or $12.18 per hp.-year, or 0.138c. per hp.-hr. 0.217c. per hp.-hr., exclusive of labor and supplies.

Creosoted Wood Block Shows Increase

Reports compiled from all sources by the various lumber associations indicate that the year 1916 marked the completion of a total of 25,000,000 sq.yd. of wood-block pavement in the United States.



The Imhoff Tanks Foamed Vigorously

Septic Tanks Reconstructed as Imhoff Tanks at Columbus

Sludge-Disposal Problem Forced Change—New Tanks Built While Half of Old Plant Was Kept in Service

Part I—Governing Conditions and Main Results

By C. P. HOOVER

Chemist-in-Charge, Division of Sewage Disposal, Columbus, Ohio

THE clarification, sludge-digestion and sludge-disposal facilities of the original design of the sewage-treatment works of Columbus, Ohio, consisted of the single-story type of septic tanks for the clarification and sludge-digestion functions and a sludge-blowoff line to the Scioto River for conveying and dispersing the sludge in the flood water of this stream.

Our early operating experience with the single-story septic tanks showed that satisfactory clarification, especially in the warm-weather months of the year, could not be maintained after vigorous sludge digestion became established and that this interference with clarification could only be obviated by a frequent removal of the sludge, the time between cleanings varying from four to six weeks. The septic tanks were operated as settling basins in order to maintain a fairly satisfactory clarification; but in a septic tank or settling basin the flowing liquor is constantly passing over the decomposing sludge, and an infection of the liquor with sludge-digestion products is inevitable. This is one of the disadvantages that cannot be overcome in the single-story septic tank.

Periods of Service Short

Time is an essential factor in the proper humification of sewage sludge; and when the sludge is frequently removed from the tanks, much of it is apt to be only partly digested and consequently offensive. It is thus evident that no practicable method of operating the single-story septic tank will obviate the constant infection of the incoming sewage and that the short periods in service which are necessary for the maintenance of a fair degree of clarification result in the production of partly digested and offensive sludge.

As previously stated, the final disposal of the tank sludge consisted in discharging and dispersing it in the flood waters of the Scioto River, which is adjacent to the works. On account of the uncertainty in the occurrence of floods in the river, it is evident that no definite schedule of sludge removal could be followed without some intermediate storage of the sludge. This method of sludge disposal was abandoned after a few years of trial, and lagooning was tried as a temporary measure. It was possible to get a gravity flow of the sludge to a borrow pit adjacent to the works. Without leveling or underdraining, this pit was used for several years, and the dried sludge was never removed. Large volumes of flushing water were required in moving the partly digested sludge from the tanks to the pit. This was disadvantageous, as was also the large surface exposure of partly digested sludge.

Sludge-Disposal Difficulties

This in general constitutes the indictment against the single-story septic or settling tank. At the time we had reached the end of our sludge-disposal resources, the Imhoff tank had established its claims of superiority as a clarification and sludge-digestion device. As it offered a solution of the difficulties that confronted us, the decision was made to convert our single-story tanks into two-story tanks of the Imhoff type and to construct suitable sludge-drying beds. Some of the largest and best Imhoff tank installations of this country were visited by J. J. Morgan, consulting engineer, and the writer, and plans and specifications for the remodeling of the old tanks were prepared. These plans were submitted for review and criticism to George W. Fuller, John H. Gregory and George A. Johnson, consulting sanitary engineers, of New York City, all of whom had been associated in the design and construction of the original works. Some changes in the design were recommended, and the plans were modified in some respects and then approved by the Ohio State Board of Health.

The construction program called for the remodeling of one-half of the old tanks during the first building season, leaving the other half available for sewage-treatment purposes. The tanks which were completed during the first season were to be in use during the following building season while the construction work was in progress on the

other half of the tanks. The construction program did not proceed according to schedule; consequently, the operating program had to be modified to the extent that sewage treatment had to be suspended from Jan. 1 to July 12, 1916, at which time 8 of the 22 Imhoff units were ready for service.

Foaming from Imhoff Tank Gas Vents

In order to treat the entire sewage flow of the city, it was necessary to operate the eight units at about double their rated capacity; and this resulted in a rapid accumulation of sludge. It was impossible to remove this sludge when it should have been removed, because the sludge channels leading from these tanks to the sludge beds had not been completed. About one month after the Imhoff units had been in service, foaming from the gas vents began. For a short time the foaming did not reduce the clarifying efficiency of the tanks, as indicated by the satisfactory removal of settleable solids and an absence of discoloration of the effluent. After a time the effluent began to deteriorate in quality, as shown by the following mean monthly values of the percentage removal of settleable solids: July, 93; August, 86; September, 71; October, 55; November, 61; mean value for the entire period, 72. The mean monthly values of the percentage removal of total suspended solids are as follows: July, 56; August, 51; September 45; October, 26; November, 13; mean value, 41.

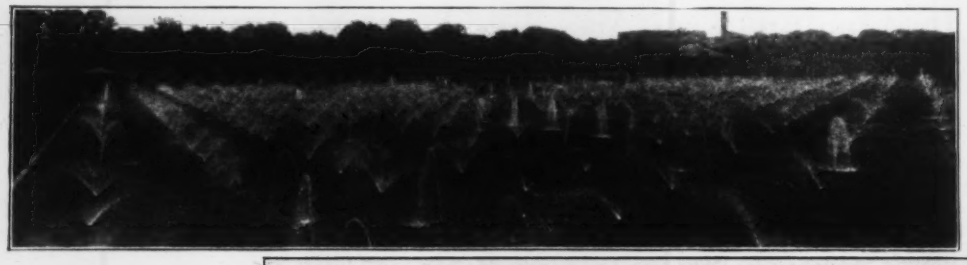
The foaming material that came over the gas-vent walls into the sedimentation chambers showed on analysis a moisture content of 82% and an ether-soluble content of 25% on a dry basis. Our experience with foaming thus far had disclosed very little in the way of remedial measures. Filling the tanks with city water, previous to placing them in service, had no preventive effect on the foaming; but there were some indications that after the tanks had become properly seeded with sludge the foaming would be pratically obviated.

As a result of our experience with these tanks, we doubt very seriously the wisdom of permitting the discharge of large quantities of mineral and organic street-flush material into them. Unless efficient separatory devices are introduced, a sewage-treatment works that serves a combined system of sewerage must handle sewage, refuse a garbage; and this resolves itself into a very difficult trea ment proposition. The mineral and organic street-flu material causes a serious wear of certain pump parts; a by becoming lodged in the eye of the impeller and with the impeller itself, an unbalancing of the impeller and serious reduction in capacity are caused. The net r sult is inefficient and costly pumping. The net resu from careful screening and efficient inclosed pump impellers is apt to be much better than that resulting from coarse screening and the use of open-type impellers.

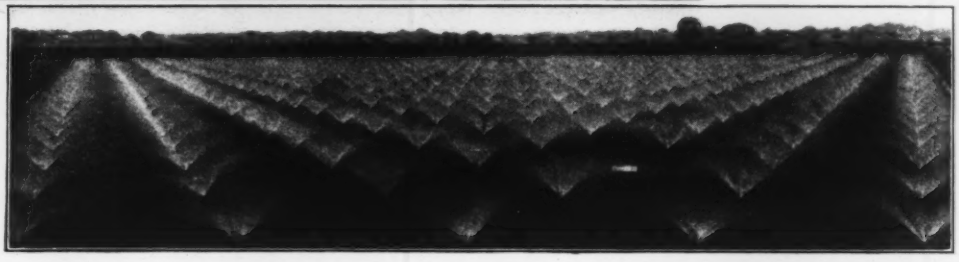
The effluents from the Columbus Imhoff tanks are discharged into a small storage basin, which has eight hopper-bottom outlets. The need for this basin lies in the fact that the sprinkling filters are dosed by hand-operated sluice gates, and the turning off of these filters for changing the screens and other short operations can be accomplished without wasting any of the tank effluent.

The effluent from the old single-story septic tanks contained a great deal of nozzle-clogging material; and as the original Columbus nozzle was screwed into the top of a cast-iron riser, the rusting of the threads made it impossible to remove the nozzle in order to free the orifice of particles that were too large to pass through it. The nozzles were made of a rather soft composition. Many nozzles were destroyed when removed, and the difficulty of handling nozzle clogging resulted in a very serious reduction in sprinkling capacity. During the summer of 1916 the sprinkler beds were equipped with a modified type of the Columbus nozzle, which consists of a short brass receiving part threaded at one end and having a slip-joint seat at the other end. Except for this seat the nozzle is exactly like the original one. The receiving piece is screwed into the riser and remains there permanently. By means of the slip joint the nozzle may be easily and quickly detached. Our experience with these nozzles during the past summer and fall has been a very satisfactory one. If the Imhoff tanks can be operated so as to obviate foaming, nozzle clogging should not be at all serious.

[Next Week: Special features of design and construction will be described by J. J. Morgan, consulting engineer, Columbus, Ohio.]



THE OLD NOZZLES GAVE A VERY UNEVEN DISTRIBUTION OF THE SEWAGE



THE SPRAYS FROM THE NEW NOZZLES COVERED THE STONE SURFACE REGULARLY

Deadlock on Cast-Iron Pipe Specifications

Pipe Users in Joint Committee of American and New England Water-Works Associations Agree on Tentative Revision—Manufacturers Oppose Change

A COMMITTEE deadlock over cast-iron pipe specifications was reported at the Richmond convention of the American Water-Works Association early this month. It was really a deadlock by courtesy, since a majority of the members of the committee were agreed that changes in the 1908 specifications are desirable, while a minority stood pat on the old specifications. The division was on the line of users against makers, four to two. The majority did not propose that new specifications be adopted at once; it merely proposed that a tentative draft of revised specifications be submitted to the membership for an expression of opinion on three proposed changes and that the committee consider the opinions submitted and report to the association next year. Even then, the specifications, if adopted, need not go into effect at once.

The minority did not wish the tentative draft to be sent to the membership. Instead, it urged a letter ballot on whether any changes whatever should be made in the 1908 specifications.

The convention voted to authorize the committee to secure the opinion of the members on points at issue for guidance in the future work of the committee.

Coöperation with New England Association

For a better understanding of the case it may be stated that the committee was created in 1911. After several years of coöperation with a similar committee of the New England Water-Works Association (this organization having adopted standard specifications before the American Association created its original committee on the subject) the committees of the two societies created a joint committee of six members, consisting of John H. Gregory, N. F. S. Russell and Walter Wood for the American Association, and Frank A. McInness, Frank A. Barbour and W. R. Conard for the New England Association. This was on Jan. 21, 1916.

The object of the joint committee was to make a tentative draft of specifications for submission to the various manufacturers of cast-iron pipe for criticism. The joint committee sent out such a draft (as printed below) on May 6, 1916, with a proposal for a later meeting of the committee with representatives of the manufacturers to discuss the tentative draft. On Nov. 22, 1916, Messrs, McInness and Gregory, as chairmen of the committees of the two associations, sent out a letter inviting the manufacturers to meet the two committees in New York on Dec. 14, 1916. At the meeting there were present nearly the entire membership of the two association committees, representatives of six manufacturers and also Leonard Metcalf, president of the American Water-Works Association, who presided over the conference.

Three major changes proposed in the specifications were: (1) "The adoption of a uniform outside diameter for all classes of pipe of the same size; (2) specifications for the permissible range of total carbon, combined carbon, silicon, manganese, phosphorus and sulphur in the metal; (3) the requirement of a relation between flexure and breaking load in test bars."

Pipe Makers Oppose Revision

After prolonged discussion of the proposed outside diameter and chemical quality of metal changes, it appeared that the manufacturers present were opposed to revising the specifications, urging, as expressed in the majority committee report submitted at the convention of the American Association at Richmond, May 10, 1917, "the expense incident to changes in present equipment, increased manufacturing difficulties and the belief that the present specifications are good enough."

Before the conference of Dec. 14, 1916, adjourned, a motion was unanimously carried requesting the manufacturers to consider the tentative draft and report to the committee by Mar. 15, 1917, "with such modifications of the specifications, paragraph by paragraph, as may seem to them desirable, with their reasons therefor." On Mar. 31, Mr. Gregory received a letter from Walter Wood and N. F. S. Russell, saying that the tentative specifications had been fully discussed at three meetings of the manufacturers and the unanimous conclusion reached that no essential changes are needed in the 1908 specification, since while not ideal they have "proved fairly satisfactory to both user and manufacturer, as evidenced by their almost universal adoption."

The full committee of the American Water-Works Association is: Chairman, John H. Gregory, consulting engineer, New York City; W. H. Randall, superintendent of maintenance, Water Department, Toronto, Ont.; Walter Wood, of R. D. Wood & Co., Philadelphia; Frank A. Barbour, consulting engineer, Boston; Edward E. Wall, water commissioner, St. Louis; N. F. S. Russell, United States Cast Iron Pipe and Foundry Co., Philadelphia.

Tentative Draft of Standard Specifications for Cast-Iron Water Pipe and Fittings Prepared by Joint Committee of the American and New England Water-Works Associations for Examination and Discussion by Manufacturers of Cast-Iron Pipe

(*Changes from present New England and American specifications are in* Italics. *Of the 21 sections, Sec. 2, "Fittings," and Sec. 12, "Flanges," are new to both of the old specifications. All the other sections include revisions of both the specifications, except Sec. 21, defining "Engineer," which is unchanged.*)

Description of Pipe

Sec. 1. The pipes shall be made with *bell* and spigot *ends or with flange ends* and shall *conform accurately* to the dimensions given in Tables Nos.—and—. They

shall be straight and shall be true circles in section, with their inner and outer surfaces concentric, and shall be of the specified dimensions in outside diameter.

Bell and spigot pipes shall be at least 12 ft. in laying length, exclusive of the bell, and flange pipes shall be at least 12 ft. in length face to face of flanges.

All classes of pipe of each size shall have the same outside diameter. All pipes having the same outside diameter shall have the same inside diameter at both ends.

The inside diameter of the lighter pipes of each standard outside diameter shall be gradually increased for a distance of about 6 in. from each end of the pipe barrel, so as to obtain the required standard thickness and weight for each size and class of pipe.

Description of Fittings

Sec. 2. There shall be two types of standard fittings, known as "Bell Fittings" and "Flange Fittings." Fittings having bell or spigot ends, or both, but no flange end or ends, shall be known as "Bell Fittings." Fittings having one or more flange ends shall be known as "Flange Fittings."

All fittings shall be made in accordance with the cuts and dimensions given in the tables forming a part of these specifications. They shall be true circles in section with their inner and outer surfaces concentric on both run and outlet except where intersections prevent. On all fittings the outside diameter of the barrel on each outlet shall be the same as the outside diameter of the pipe of corresponding size.

For pipes from 4 to 20 in. in diameter, inclusive, one class of fittings known as Class D fittings shall be furnished for all classes of pipe. For pipes over 20 in. in diameter, two classes of fittings, known respectively as Class AB and CD fittings, shall be furnished. Class AB fittings for Class A and Class B pipes, and Class CD fittings for Class C and Class D pipes.

Any fitting not shown in the tables hereto attached shall be known as a "Special Fitting."

Variation in Diameter of Bells and Spigots

Sec. 3. Especial care shall be taken to have the *bells* and spigots of the required size. The *bells* and spigots will be tested by circular gages and no pipe *or fitting* will be accepted *which, for any cause, does not comply with the specified joint space, except as hereinafter allowed.*

The inside diameters of the bells and the outside diameters of the spigot ends of pipes shall not vary from the standard dimensions by more than 0.06 in. for pipes 16 in. or less in diameter; 0.08 in. for pipes 18, 20 and 24 in. in diameter; 0.10 in. for pipes 30, 36 and 42 in. in diameter; 0.13 in. for pipes 48, 54 and 60 in. in diameter; *and 0.18 in. for pipes 72 and 84 in. in diameter.*

The inside diameters of the bells and the outside diameters of the spigot ends of the fittings shall not vary from the standard dimensions by more than 0.08 in. for fittings 16 in. or less in diameter; 0.10 in. for 18-, 20- and 24-in. fittings; 0.13 in. for 30-, 36- and 42-in. fittings; 0.16 in. for 48, 54- and 60-in. fittings; and 0.20 in. for 72- and 84-in. fittings.

Variation in Thickness

Sec. 4. For pipes whose standard thickness is less than 1 in. the thickness of metal in the body of the pipe *shall not vary more than* 0.08 in. from the standard thickness, and for pipes whose standard thickness is 1 in. or more the variation shall not exceed 0.10 in., except that for spaces *the length across which in any direction does not exceed 8 in., a decreased thickness not exceeding 0.02 in. will be permitted, and for spaces the length across which does not exceed 16 in. in any direction, an increased thickness, not exceeding 0.05 in. will be permitted*—both in excess of the allowances above stated.

For fittings, a variation 50% greater than that allowed for pipes shall be permitted.

Allowable Percentage of Variation in Weight

Sec. 5.—No pipe shall be accepted, the weight of which shall be less than the standard weight by more than 5% for pipes 16 in. or less in diameter and 4% for pipes more than 16 in. in diameter, and no excess above the standard weight of more than the above given percentages for the several sizes shall be paid for. The total weight of pipe to be paid for shall not exceed, for each size and class of pipe received, the sum of the standard weights of the same number of pieces of the given sizes and classes by more than 2%.

No *fitting* shall be accepted, the weight of which shall be less than the standard by more than 10% for *fittings* 12 in. or less in diameter and 8% for larger sizes (except that curves and Y-branches may be 12% below the standard weight); no excess above the standard weight of more than the above given percentages for the several sizes shall be paid for. *The total weight of fittings to be paid for shall not exceed the sum of the standard weights of the same number of pieces of the given sizes and classes by more than 5%.*

Quality of Iron

Sec. 6. All pipes and fittings shall be made of cast iron of good quality and of such character as shall make the metal of the casting strong, tough and of even grain, and soft enough satisfactorily to admit of drilling and cutting. The metal shall be made without *the admixture of any inferior material*, and shall be remelted in cupola or air furnace.

The contractor shall furnish the engineer with copies of the mill analyses of each heat or run of metal, and shall furnish samples to the engineer for check analyses when required.

The metal for the pipes and fittings shall fulfill the following chemical requirements: Total carbon, 3 to 3.75%; combined carbon, 0.5 to 0.75; silicon, 1.6 to 2; manganese, 0.35 to 0.55; phosphorus, not to exceed 0.90; sulphur, not to exceed 0.10%.

Tests of Material

Sec. 7. Specimen bars of the metal used, each being 26 in. long by 2 in. wide and 1 in. thick, shall be made, without charge, as often as the engineer may direct, and in default of definite instructions the contractor shall make and test at least one bar from each heat or run of metal. The bars, when placed flatwise upon supports 24 in. apart and loaded in the center, shall support a load of 2000 lb., and show a deflection of not less than *0.32 in. before breaking, and an increase in deflection of not less than 0.03 in. for each 200 lb. of ultimate breaking load in excess of 2000 lb.*

The contractor shall have the right to make and break three bars from each heat or run of metal, and the test shall be based upon the average results of the three bars. Should the dimensions of the bars differ from those above given, a proper allowance therefor shall be made in the results of the tests.

Casting of Pipe

Sec. 8. The pipes shall be cast in dry sand molds in a vertical position. Pipes 16 in. or less in diameter *may* be cast with the *bell* end up or down, unless *otherwise* specified *by the purchaser.* Pipes 18 in. or more in diameter shall be cast with the bell end down.

The pipes shall not be stripped or taken from the pit while showing color of heat, but shall be left in the flasks for a sufficient length of time to prevent contraction by subsequent exposure.

Quality of Castings

Sec. 9. The pipes and fittings shall be smooth, free from scales, lumps, blisters, sand holes and defects of every nature which, in the opinion of the engineer, unfit them for the use for which they are intended. No plugging or filling will be allowed.

Marking

Sec. 10. *Each* pipe and *fitting* shall have distinctly cast upon it the initials of the maker's name, *a letter designating the class to which the casting belongs, and figures showing the year in which it was cast. When cast to order, if required by the purchaser, each pipe and fitting 6 in. or more in diameter shall also have cast upon it a serial number, designating the order in point of time in which it was cast, the serial number to be placed below the date, thus:*

1916	1916	1916
1	2	3

etc., and any initials, not exceeding four, *or a symbol,* which may be required.

The letters and figures shall be cast on the outside and shall *be not* less than 2 in. in length and ¼ in. in relief for pipes *and fittings 10 in.* in diameter and larger. For smaller sizes of pipe, the letters may be 1 in. in length. The weight, *serial number* and class letter shall be conspicuously painted in white on the inside of each pipe and *fitting* after the coating has become hard.

Defective Spigot Ends May Be Cut

Sec. 11. Defective spigot ends on pipes 12 in. or more in diameter may be cut off in a lathe, and a half-round wrought-iron or *mild-steel* band, shrunk into a groove, cut at the end of the pipe. Not more than 12% of the total number of accepted pipes of each size shall be cut and banded, and no pipe shall be banded which is less than 11 ft. in length, exclusive of socket.

Pipes may be cast with shrink-head above spigot head, and such pipe shall not be considered as cut pipe in determining the percentage above referred to.

In case the length of a pipe differs from 12 ft., the standard weight of the pipe given in Table — shall be modified in accordance therewith.

Flanges

Sec. 12. *Flanges shall be cast solid and shall be accurately faced smooth and true. Holes for bolts or studs shall be drilled, and the flanges shall be tapped where required. The contractor shall furnish and deliver all bolts and nuts for bolting on manhole covers. The bolts and nuts shall be of the best-quality wrought iron or mild steel, with good, sound, well-fitting threads, the nuts to be cold punched. The heads and nuts shall be hexagonal and shall be trimmed and chamfered. The heads, nuts and threads shall be of the United States Standard sizes.*

Cleaning and Inspection

Sec. 13. All pipes and *fittings* shall be thoroughly cleaned and subjected to a careful hammer inspection. No casting shall be coated unless entirely clean and free from rust, and approved in these respects by the *engineer* immediately before being *coated.*

Coating

Sec. 14. Every pipe and *fitting* shall be coated inside and out with coal-tar pitch varnish. *Each pipe and fitting shall be heated to a uniform temperature of 320° F. in a suitable oven before it is dipped, and the material in the tank shall also be maintained at this temperature, and each pipe and fitting shall be kept in the bath for at least five minutes, during which time the temperature of all parts of the bath, including the bottom, shall be as specified.*

After removing the pipe from the bath, it shall be suspended or set in a vertical position until the coating has solidified.

The coating shall be of pitch, made from coal tar, distilled until the naphtha is removed, and sufficient oil to make a smooth coating, tough, elastic, strongly adhesive to the metal, tough and tenacious when cold, and not brittle nor with any tendency to scale off. Coating shall not be soft enough to flow when exposed to summer heat, nor brittle enough to crack and scale when exposed to a temperature below freezing.

The pitch shall be straight-run, coal-tar pitch, which shall soften at 60° F. and melt at 100° F., being a grade in which distillate oils, distilled therefrom, shall have a specific gravity of 1.05. The pitch shall not contain less than 10% nor more than 18% of free carbon.

Fresh pitch and oil shall be added to the tank when necessary to keep the mixture of the proper consistency. The oil used for this purpose shall consist of heavy, coal-tar oil, with a specific gravity of not less than 1.04 at 60° F., and which shall not lose more than 5% of oil when distilled up to 400° F.; not more than 40% of oil when distilled up to 450° F. If the material in the tank thickens or deteriorates when used, the tank shall be emptied of its contents and refilled with fresh material when deemed necessary by the engineer.

Fittings which are too large to be immersed shall be coated with hot varnish by hand, the fittings to be heated as specified above and the coating applied immediately thereafter.

Faces of flanges and finished surfaces shall be coated with a mixture of grease and white lead immediately after they have been faced and drilled.

Any pipe or *fitting* that is to be recoated shall first be thoroughly scraped and cleaned.

Hydrostatic Test

Sec. 15. When the coating has become hard, the pipe shall be subjected to a proof by hydrostatic pressure, and

if required by the engineer, they shall also be subjected to a hammer test under this pressure.

The pressures to which the different sizes and classes of pipe shall be subjected are as follows:

Class	Hydrostatic Pressure Lb. Per Sq.In. Diameter Less Than 20 In.	Diameter 20 In. and Over
A	300	150
B	300	200
C	300	250
D	300	300

The full hydrostatic pressure shall be applied to the pipes for one minute on pipes 12 in. and less in diameter; for two minutes on 14-, 16-, 18-, 20- and 24-in. pipes; for three minutes on 36-in. pipes; and for five minutes on pipes larger than 36 in. in diameter.

Fittings shall also be subjected to a proof by hydrostatic pressure, provided the same is specified in the contract. If tested, the hydrostatic pressures to which the fittings shall be subjected shall be the same as those to which pipes of the same size and class would be subjected and shall be applied for the same length of time.

Weighing

Sec. 16. The pipes and *fittings* shall be weighed for payment under the supervision of the engineer after *they have been coated.* If desired by the purchaser, the pipes and *fittings* shall be weighed after their delivery. The weight so ascertained shall be used in the final settlement, provided such weighing is done by a legalized weigh master. *The cost of weighing after delivery shall be borne by the purchaser.*

Bids shall be submitted and final settlement made upon the basis of a ton of 2000 lb.

Contractor To Furnish Men and Material

Sec. 17. The *contractor* shall provide all tools, testing machines, materials and men necessary for the required testing, inspection and weighing at the foundry of the pipes and *fittings*, and should the purchaser have no inspector at the *foundry*, the contractor shall, if required by the purchaser, furnish a sworn statement that all of the tests have been made as specified, this statement to contain the results of *the chemical and physical tests.*

Power To Inspect

Sec. 18. The engineer shall be at liberty at all times to inspect the material at the foundry and the molding, casting and coating of the pipes and *fittings*. The forms, sizes, uniformity and conditions of all pipes and *fittings* herein referred to shall be subject to his inspection and approval, and he may reject, without proving, any pipe or *fitting* which is not in conformity with the specifications or drawings furnished.

Inspector To Report

Sec. 19. The inspector at the foundry shall report daily to the contractor all pipes and *fittings rejected*, with the causes for rejection.

Castings To Be Delivered Sound and Perfect

Sec. 20. All pipes and *fittings shall* be delivered in all respects sound and conformable to these specifications. The inspection shall not relieve the contractor of any of his obligations in this respect, and defective pipes or *fittings* which may have passed the engineer at the foundry or elsewhere shall be at all times liable to re- tion, when discovered, until the final completion and justment of the contract, provided, however, that contractor shall not be held liable for pipes or *fitti* found to be cracked after they have been accepted at agreed point of delivery. Care shall be taken in handl the pipes *and fittings* not to injure the coating, and pipes, *fittings* or other material of any kind shall placed in the pipes or *fittings* during transportation at any time after they have *been coated.*

The contractor shall not be held responsible for any expenses or damages incurred in handling or using the castings after they have been accepted at the agreed point of delivery. Any pipe or fitting that proves defective shall, when requested, be replaced by the contractor, the measure of the damage not to exceed the value of the casting found defective. The contractor shall have the right to call for the defective casting to be returned to him at the agreed point of delivery before any allowance for the same is demanded.

Definition of the Word "Engineer"

Sec. 21. Wherever the word "engineer" is used herein, it shall be understood to mean the engineer or inspector acting for the purchaser, and his properly authorized agents, limited by the particular duties intrusted to them.

Brightening Up Filter-House Interiors

The desirability of giving more attention to the appearance of the interior of water-filtration plants was commented on by Lewis I. Birdsall, superintendent of water filtration, Minneapolis, Minn., in a paper on the operations of his plant, read at the May convention of the American Water-Works Association. Mr. Birdsall's remarks follow:

"It has occurred to the author that more attention might well be given by designing engineers to the æsthetic side of a water-purification plant. By this I mean giving to the inside of a filter plant an appearance of light and cleanliness through the liberal use of white tile and paint. The added expense to the municipality or private water company would be more than offset by the favorable impression created in the minds of the water consumers, who in Minneapolis, for example, visit the plant to the number of 10,000 yearly. Most filtration plants present a creditable appearance externally, proper attention having been given to architectural design and landscape gardening. But inside the plant it is usually gloomy and oppressive to the casual visitor. What a difference there would be in the impressions given if the sides of the filter boxes above the sand line were covered with white tile, the floor of white tile, and a wainscoting of tile extending around the side walls of the filter house. While paint on the walls above the wainscoting and on the ceiling would reflect light downward into the filter, and the whole appearance of the place would be changed. There would be added incentive to the employees to keep the place absolutely clean, and there would be no more spitting in dark corners. Some work along this line is being done in Minneapolis. The walls inside the plant are of white brick, and these are being painted with flat white wall paint."

New Cargo Masts Developed for New York City Piers

Freight-Handling Masts on Piers in New York Harbor Show Improvement in Detail in Last Few Years

By CHARLES W. STANIFORD

Chief Engineer, Department of Docks and Ferries, New York City

IN NEW YORK harbor cargo is normally handled from pier to ship by overhead lines controlled by hoists on the ship or on the pier. To provide an inshore support for such lines high masts alongside of or integral with the pier shed columns are used. The detail design of these masts and their appliances, which has changed considerably since the first large piers were built, makes an interesting story of engineering development.

In general where extreme conditions of loading exist in single-story sheds, that is where the greatest possible height is desired above the deck for the suspension of the hoisting blocks, in some cases as high as 70 ft., Oregon pine masts have been used, footing on the deck just outside of the shed. These were placed about 60 ft. apart and connected with wire cable (Fig. 1). Where a more moderate height was sufficient, say 50 ft., the steel side columns of the shed were extended upward and connected with wire cable, as in Fig. 2.

Side Columns Extended in Two-Story Sheds

In the two-story sheds, to obtain a sufficiently rigid support for the blocks handling cargo to both upper and lower decks, it has been found advisable to extend the side columns, which are spaced 20 ft. apart, to the desired height above deck, brace the extension back to the upper chord of the roof truss and connect the cargo extensions at the top ends by rigid steel members. Fig. 3 shows the first type of column extension mast used at the Hoboken piers and at the piers of the transatlantic steamship terminal built by the city of New York between 14th St. and 23rd St., North River. These masts are extensions of the steel side columns every 20 ft. and are placed 68½ ft. above the deck. They have given satisfactory service, and have been adopted by the designers of a number of other piers.

In discussing with the representatives of the steamship companies who might possibly be the lessees of the 1000 ft. pier now being built by the Department of Docks at West 46th St., North River, it was found that the type as outlined in the preceding paragraph and which they are now using, was entirely satisfactory except that with steamships of extreme size, for which the pier was to be built, a height of 80 ft. from the deck was desirable.

Provision for Extra Large Ships

This was provided for by the Department by extending the support outshore at the top a distance of about 2 ft.,

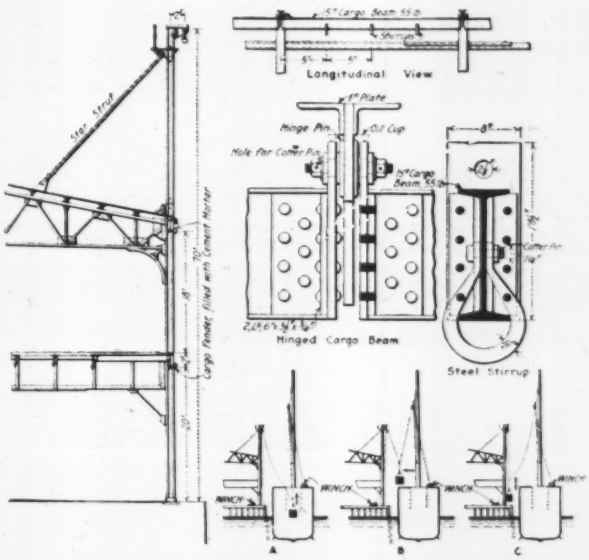
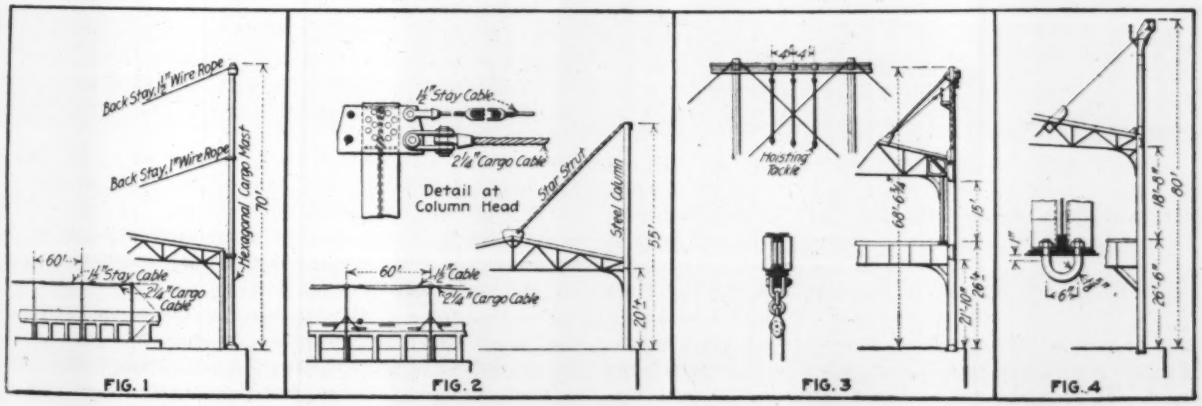


FIG. 5. LATEST CARGO MAST HAS OVERHANGING TOP AND PIVOTED SHEAVE BEAM

by a curved built member carrying the cargo beam. This detail is shown in Fig. 4. It was designed so as to place the support for the blocks away from the axis of the columns, providing an easier approach and wear for the hoisting line against the cargo door head girders, which act as fenders for the wear of the running gear. These wearing fenders were found to be subject to considerable wear at the Chelsea piers, where they were made of yellow pine. In all recent sheds built by the Department, the yellow-pine fenders have been replaced by a curved steel plate riveted to the door head girders,



FIGS. 1 TO 4. TYPES OF FREIGHT-HANDLING MASTS ON DIFFERENT NEW YORK PIERS

the interior being filled with cement mortar. This decided improvement is shown in Fig. 5.

The study for improvement in this cargo hoisting apparatus led the writer to adopt another change as a betterment, after receiving the suggestion from M. Lenke, Assistant Engineer in this Department. It was incorporated as an original design of the Department in the construction of the double-deck sheds at West 55th and West 57th Sts., North River, where it is now being erected. Since the publication of these plans, the same method of construction has been adopted for two new piers on the New Jersey side of the North River.

This detail, shown in Fig. 2, is regarded by the writer as the latest and best method for cargo handling so far developed. The side columns, spaced every 20 ft., are extended to the desired height, in this case 70 ft. above the deck, and may be used as high as 80 ft., as at the West 46th St. pier. The top of the column is extended outboard about 2 ft. by framing an extension support for the cargo girder. Instead of the rigid cargo beam from which the stirrups for the support of the running gear are attached, this beam is made to revolve on pins at the ends, as shown in detail in Fig. 2, so that the cargo beam is always normal to the pull from the hoisting ropes.

A typical operation of the hoisting units on one of these new piers is shown in the small sketches in Fig. 5. In this operation there is the winch in the pier or warehouse and the winch on the ship, both being utilized in unloading a package from the ship. The progressive views show (a) the load being raised from the hold by the ship hoist to the desired height for the story to which it is to be delivered; (b) the dock winch taking up the slack and drawing it to the side of pier or warehouse, and (c) the dock winch lowering to the deck as the ship winch slackens.

Best Results Not Obtained with Thick Bituminous Carpets

Macadam Roads Are Better Maintained with a Thin Oil That Will Penetrate and Harden Quickly

By C. A. HOGENTOGLER

Assistant Professor of Civil Engineering, University of Idaho

IN VIEW of the extensive use of bituminous treatments for waterbound road and street surfaces, of the different materials used and the confusing reports of the satisfaction resulting, a careful inquiry should be made as to what is the purpose to be attained by the use of bituminous carpets, and what qualities are lacking in a waterbound surface that such treatments must supply.

Under the thrust delivered by the driving wheels of motor vehicles, especially at high speed, the stone-dust binder near the top is loosened and forced out from between the stones composing the top layer. Serious results follow this loosening, but it is evident that they would be avoided if the particles of binder could be restrained from separating under the stress to which they are subjected. Lack of sufficient adhesion in the binder is the weakness of waterbound surfaces, and the remedy lies in incorporating with the dust a stronger binder which will prevent the separation of its particles. Since this can be accomplished only by capillary attraction, the material used must be liquid at ordinary temperatures. It should also attain, when set, a hardness and toughness similar to that of a hard paint.

Thick Carpets Bunch or Crack

Carpets resulting from hot applications of heavy bituminous materials often do not answer requirements, for, since there can be little or no penetration, the condition of the binder between the stones of the top layer is not improved. The stress which dust cannot resist at the top is not greatly reduced in intensity at a depth of from $\frac{1}{4}$ to $\frac{1}{2}$ of an inch—the thickness of the carpet—and cannot be resisted but results in a tendency toward bunching, when soft, and cracking off, when hard materials are used. If it is desired to use a heavy bituminous material, the surface should be treated with a lighter material first. If the traffic is such as to demand a carpet only to prevent wear, a different surface would possibly prove more economical.

After selecting the proper cold material, the amount to be applied or rather the thickness of the resulting coat must be considered. It is known that two coats of paint on a floor wear well, but how long would a thickness of possibly $\frac{1}{8}$ of an inch of the same paint on the same floor last before cracking off? For the same reasons, good materials often prove unsatisfactory because of attempts to build up a thick wearing mat which does not necessarily mean better bond between the stones, and it is the bond only that is to be strengthened.

Seven Conclusions Are Given

From experiments, covering the past five years, carried on along the above lines—first, of selecting a proper material with regard to its ability to penetrate, and to its hardness and toughness; and second, of obtaining a coat of minimum instead of maximum thickness—the following conclusions have been reached:

(1) In addition to the above requirements, the bituminous material should have a permanent binding power and should be one that will set so quickly as to prevent inconvenience to traffic and pedestrians. (2) A covering of clean hard sand whose particles average not over $\frac{1}{20}$ of an inch in diameter, will result in the most compact and watertight coat. (3) The surface must be dry and should be swept until the stones show. (4) The stones of the top layer of the surface should be not less than $1\frac{1}{2}$ in. (5) For coatings, except the first, a rotary broom attached to the distributor will be of benefit. (6) A newly constructed surface should be allowed some time to season before receiving its first treatment. (7) Best results are derived from the use of refined coal-tar and a cut-back oil. A hard asphalt thinned with a volatile oil will also prove satisfactory.

As a result of the study of much unsatisfactory work, two conclusions stand out; first, if such material is used as will penetrate into and make the dust-binder between the stones of the top layer of the surface so hard and tough that it will resist the stresses which come upon it, and second, if precautions are taken to avoid more than a thin skin on the top, waterbound macadam can be economically maintained.

Progress in the Rail Problem Marked by Sharp Differences in View

Rail Fractures Reduced One-Half in Two Years; Different Authorities Blame Breaking of Rails on Mill Defects, Gagging and Overstress in Service. A Bend Test Is Proposed in Place of the Drop Test.

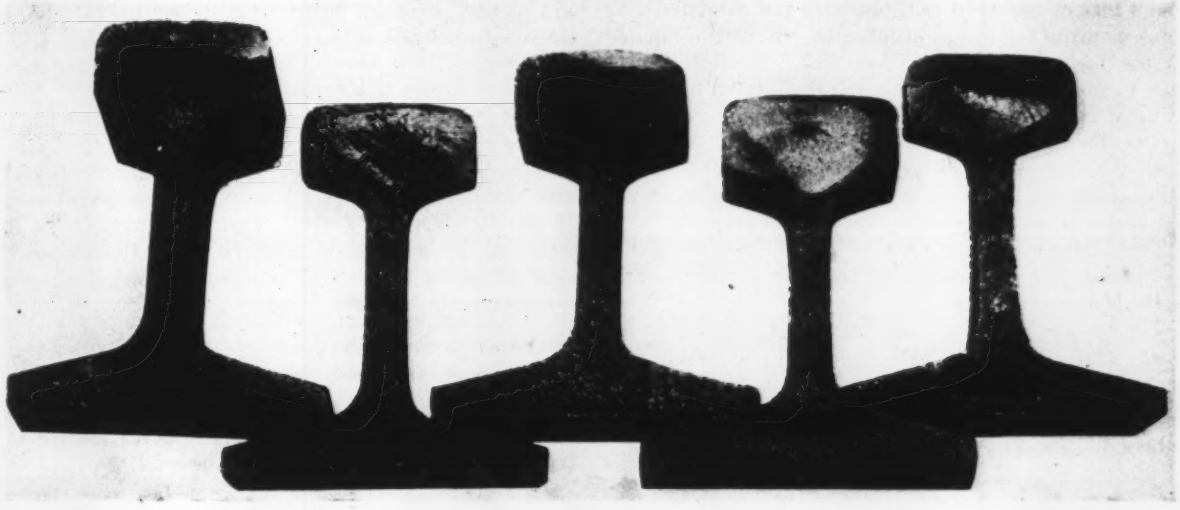


FIG. 1. GROUP OF FIVE TRANSVERSE FISSURES DEVELOPED AFTER SHORT SERVICE IN THE TRACK

NOTABLE progress in rail study was made apparent by the studies presented before the American Railway Engineering Association recently, and by the Iser wreck report of the Interstate Commerce Commission, dealing with transverse fissures in rails. The greatest fact brought out is that rail breakages decreased one-half in two years. But no explanation for this reduction has been offered, and the statements of various experts indicate that no agreement of opinion seems in prospect with regard to the causes of rail breakages.

The prospective adoption of a bending test in place of the long-established drop test for rails is another radical novelty of the rail situation. The Pennsylvania R.R., which originated it, has put the bend test into tentative use; and other bodies have it under consideration.

Great Improvement Shown by Rail-Failure Statistics

The diagram, Fig. 2, summarizes much of the statistical compilation of rail failures conducted during the last eight years. This diagram was presented by M. H. Wickhorst, engineer of tests for the Rail Committee of the American Railway Engineering Association, at the association's recent meeting. The committee makes its comparison of rails on the basis of five years' service, counting the aggregate failures during the first five years in the track. On this basis the heavy line in Fig. 2 shows the improvement in the rails rolled (and laid) in 1909 and 1910 as compared with those of 1908. The 1910 rails showed about 200 breakages per 100 track-miles in the five years, while the 1908 rails showed nearly 400—the precise figures for the three years' rollings are 398.1, 277.8 and 198.5.

Neither Mr. Wickhorst nor the Rail Committee offers an explanation of this decrease in rail failures, but W. C. Cushing, chief engineer maintenance-of-way, Pennsylvania Lines, southwest system, says the improvement has been due "in addition to the increased weight, strength and stiffness of rail sections, for the most part to improvements in the specifications, which bring about a larger discard from the top of the ingot and a more rigid inspection of the fracture of the test piece." Presumably this refers to improvement in 1909 and 1910 rail over 1908, but he gives no data to show whether heavier and stronger rail was produced in 1909 and 1910, or whether larger discard and closer inspection were practiced. Until quite recently, specifications did not call for larger discard than old-established mill practice provided.

The committee statistics cover such large mileages of track that local or chance variations are almost out of the reckoning; in other words, the improvement in rail (or in track) is real. To make this point convincing,

TABLE I. TONNAGE AND MILEAGE OF RAIL LAID 1910 TO 1915

Year Rolled and Laid	Bessemer		Openhearth		Total	
	Tons	Track-Miles	Tons	Track-Miles	Tons	Track-Miles
1910	647,616	4,678	969,075	6,909	1,616,691	11,587
1911	317,818	2,264	805,489	5,717	1,123,307	7,981
1912	230,318	1,657	1,235,974	8,717	1,466,292	10,374
1913	122,794	998	1,403,848	9,671	1,526,642	10,669
1914	52,837	380	976,852	6,681	1,029,689	7,061
1915	13,295	99	621,603	4,187	634,898	4,286

Table I is reproduced from Mr. Wickhorst's report; it shows the tonnage and mileage of rails laid in the years from 1910 to 1915, so far as the statistics apply to the rails. The track mileages laid per year will be seen to range from 4300 to 11,600.

Openhearth Rail Is Safer Than Bessemer

As this table shows a steady increase in the proportion of openhearth and bessemer, in the new rail, emphasis is given to another grouping of the figures, which shows that of the 1910 rail, bessemer rail exhibited 1.54 times as many failures as openhearth rail, both computed on the basis of the same track unit. Similarly, 1911 rails in four years' service give the ratio 1.55; 1912 rails in three years' service, 1.43; and 1913 rails in two years' service, the ratio 1.42. These figures indicate that, even if all the 1908 rails had been bessemer and all the 1910 rails openhearth, the change would not fully account for the improvement as regards total rail failures.

These figures for the first time give definite proof that openhearth rail is superior to bessemer, under current methods of manufacture.

The average weight of new rail has varied slightly between 1910 and 1915; 1910 openhearth averaged 89.2 lb. per yd., and 1915 openhearth 99.2 lb. per yd. The bessemer figures were somewhat more erratic.

Iser Wreck Furnishes Occasion for Elaborate Rail Study

The Interstate Commerce Commission's rail studies, continued for now nearly five years, forming a progressive series of investigations, have been brought to a conclusion for the present by the studies made in connection with the Iser wreck, reported in a bulletin just issued. The wreck occurred at Iser, Tex., Jan. 31, 1916, and was due to the breaking of an 80-lb. A.S.C.E. rail, rolled in 1904. The rail broke in eight places, each showing a transverse fissure, and subsequently revealed seven more such fissures when the pieces of the rail were examined and broken. Of the 15 fissures, only two were in the outer half of the rail head. Neither chemical nor structural anomaly of the steel was found at the fissures. This same fact was observed in all prior rail fissures studied by the commission.

The earlier studies showed that new rails which have not yet seen service contain large internal stresses. These initial stresses are produced by the deformation of the rail in rolling and the different rates of cooling and are subsequently again modified by the gagging; they are erratic in their distribution, corresponding to the variation in the causes.

However, subsequent studies showed that rails acquire very high internal stresses as the result of service, and these service stresses make the initial stresses negligible. The initial stresses are soon neutralized and disappear and are replaced by those stresses that service develops.

The internal stresses are produced by the bending of the rail under wheel loads and by the squeezing out of the metal at the tread by effect of the rolling action of the wheels. The observed fact is that a rail in the tra has a strong longitudinal compression locked up in t metal at the top of the head and a longitudinal tensi in the center of the head. Earlier accident reports of t Interstate Commerce Commission seemed to repres the view that the tension within the rail head is produc by the compression induced in the tread metal by its flo under the wheel pressure. The Iser report, howeve considers that the tension is due to the bending of th rail and arises from excessive bending stress, in which th yield point of the outer fibers is passed. Removal of th wheel load then leaves tension in the fibers overstresse in compression. Thus, tension is found in the rail head and would be in greatest amount at the very tread face, except for the modifying effect of the wheel rolling, or peening effect.

The best proof of the relation of service to internal stresses in the rail is found in the fact that when a rail is taken up and reversed (gage side placed out) the stresses in it become reversed, right to left.

Internal stresses caused by service were measured in a piece of the Iser rail, showing the following results: Compression in the top of the rail, where the wheel pressure acts to squeeze and roll the metal, ranges to about 15,000 lb. per sq.in.; tension prevails throughout the interior of the head, up to 6300 lb. per sq.in., except directly along the sides of the head, where there is compression in amounts of 3000 to 8000 pounds.

Transverse Fissures Produced Experimentally by Repeated Bending in the Gag Press

A significant experiment was made, in which transverse fissures were produced in rails never laid in the track. Quoting from the Iser report:

> By means of progressive gagging, interior transverse fissures have been developed in 24 new rails. Half rail-lengths were used for convenience, the number of blows upon which in the aggregate amounted to nearly 1½ millions. Each blow of the gag caused a permanent set in the rail. The number of blows delivered at any one point on a rail ranged from 800 to 400. It was also demonstrated that control could be exercised over the position of the nucleus of the transverse fissure within the head of the rail. Central, vertical loading produced a transverse fissure in the middle of the width of the head. By inclining the rail and applying the load on one side of the head, a transverse fissure was produced on the side which was loaded.

These fissures were very similar to those observed in failures in the track, but were smaller and showed less burnishing. The important fact is brought out, also, that transverse fissures in the track rarely occur in the outer half of the head. In a group of 663 rails fissured in service, 535 had the fissure on the gage side of the head and 128 in the center of the head; none had fissures in the outer half of the head. This is held to support the conclusion that the fissure occurring in track service arises from conditions like those in repetitive gagging—that is, is a fatigue fracture.

Blame for Transverse Fissures Is Placed Squarely on Excessive Stresses of Railway Service

Bringing together all the results of laboratory studies and rail experience in this report, J. E. Howard (of the Interstate Commerce Commission's Division of Safety) makes the following summary of fact and statement of conclusions:

> Neither chemical analyses nor microscopic examinations have shown a definite cause for the development of transverse

fissures. They have occurred in rails of different weights; in those of different ingot positions; in the product of each of the two great methods of steel making, bessemer and open-hearth; in direct-rolled rails and in those from reheated blooms; in rails laid on curves and in those on tangent track; over ties and between them; they have made their appearance in the different seasons of the year, and in rails rolled in the different seasons; they occur where, according to chance, the rails may have been gagged and from the number and proximity of the fissures, where they probably were not gagged; they have displayed themselves singly, and independent of other types of rupture, and also associated with shearing fractures or seams which have developed in planes at right angles to the fissures; they are found in the head and not in the base of the rail; they appear in rails which show very little wear; they are not confined to any one rail mill, nor to Northern or Southern mills, nor to any one year's rolling, but have been displayed by rails rolled at periods of time separated by not less than two decades. The latter fact should remove doubts concerning any peculiar conditions having found their way into modern mill practice influencing this type of failure.

On the other hand, traffic has increased, wheel loads have increased, and speeds have increased; and transverse fissures are in general found where these conditions are well advanced. The girder strength of the rails has been increased, while the impinging pressures of the wheels still remain

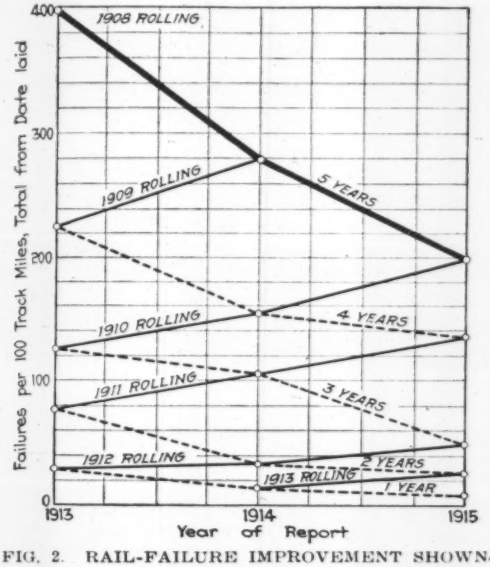


FIG. 2. RAIL-FAILURE IMPROVEMENT SHOWN BY STATISTICS

without amelioration. It is a disquieting matter that rails of the heavier sections recently laid have displayed transverse fissures. Mere increase in weight of section has not brought with it immunity from failure in this manner. It gives emphasis to the need of acquiring further data upon the features which have been discussed in this report.

The conclusion seems well founded that transverse fissures are fatigue fractures, and that they develop in rails which are structurally and chemically free from any known defect. It is a modified type of fatigue fracture in which there is a compressive component in the rail next the running surface of the head. The presence of this compressive component accounts for the interior origin of the transverse fissure. It constitutes the difference which the introduction of the term "transverse fissure" was intended to emphasize over the common type of fatigue fracture in which this component is absent and which in consequence thereof has an exterior origin.

The compressive component represents the state of internal strain caused by the cold-rolling of the wheels on the top of the head after the rail has reached the track.

The continued use of rails without exact knowledge upon their resistance to repeated alternate stresses, which constitutes their regular function in service, and without exact knowledge upon the magnitude of the track stresses which they daily receive, presents an engineering anomaly. . . . Data are needed upon the magnitude of the track stresses, and upon the limit of endurance of rails to such repeated stresses. The magnitude of the loads received and the number of repetitions are factors which determine the life of the rail against fatigue fractures.

In these words the blame for rail breakages of the transverse-fissure type is placed squarely on excessive track service. Equally unmistakable is the conclusion of Mr. Howard, joined in by H. W. Belnap, chief of the commission's Saftey Division, that neither mill defects nor peculiarities of chemical composition are responsible for transverse fissures, *even in contributory degree.*

P. H. Dudley's Views Presented by the Rail Committee

The already published views of Dr. P. H. Dudley on causes of transverse fissures were again brought forward, in somewhat amplified form, by the Rail Committee of the American Railway Engineering Association. These views are: That occasional rails are cooled improperly, so that the interior metal of the head does not acquire the proper constitution; that such rails, while being straightened in the gag press, are injured by the formation of internal cracks; and that normal service stresses enlarge these cracks by detail growth until the rail breaks.

Dr. Dudley says that transverse fissures have not occurred "in the countless thousands of rail heads of physically homogeneous metal." He describes a transverse fissure as comprising a nucleus that passes between the grains of the steel, and an outer part which passes through the grains. This is in contradiction with Mr. Howard's observations, which show all portions of the fissure passing through the grains, no part following the grain boundaries.

Taking issue sharply with Mr. Howard's conclusions, Dr. Dudley touches first on the fact that only few rails develop transverse fissures, though many other rails receive the same service:

> Rails from the same melt, adjacent to one which developed a fissure in the track, are also sent to be tested, and in several of these, which have been subjected to the same wheel loads as those rails in which fissures developed, neither cores nor fissures were found.

He then opposes the excessive-service explanation, in a passage containing the following:

> There are hundreds of thousands of heavy rails which I rolled in the winters of 1892, 1893 and 1894 still under heavy freight traffic, and have carried 300 to 350 million tons, and not one of them has developed an interior transverse fissure. . . . The composition was adjusted for heavy service. . . . The rails in the track now appear to be in good serviceable condition.
>
> The actual proof of service is more valuable to the railroads of the United States than the opinion which has been expressed that every rail, no matter how well designed and made, is subject to the development of interior transverse fissures under the present wheel loads.

Segregation and Unsoundness Blamed for Transverse Fissures

A statement by W. C. Cushing, above quoted, tended to find the explanation of rail failures in the defective top of the ingot. More directly this view was emphasized by Mr. Cushing in his quoting with approval a recent proposal by English metallurgists to place ingot molds with large end up. He further remarks: "Such a method is already in use in some of the plants of the United States, and where it has been used the results are considered as satisfactory."

M. H. Wickhorst, in a remarkably interesting paper entitled "The Rail Failure Situation," which is acknowl-

edged by the Rail Committee to represent its views, takes direct issue with both Howard and Dudley by the following statement:

> There are two general causes for rail failures, as far as the rail itself is concerned: (A) defective condition of the interior of the upper part of the ingot, such as segregation of carbon, phosphorus and sulphur, blow-holes and slag, causing split heads and fissures; (2) seams in the bottom of the base, causing broken bases and broken rails.

Cause (1), covering transverse fissures, puts the blame on segregation, blow-holes and slag. But a number of fissure rails reported upon in detail by Mr. Wickhorst himself, at the same meeting, showed no distinct segregation nor slag; they had internal longitudinal cracks of unknown nature. Mr. Howard found no segregation, no slag and no unsound structure in most of the fissured rails studied by him. Dr. Dudley fails to report segregation or associated top-of-ingot defects among the fissure conditions observed by him.

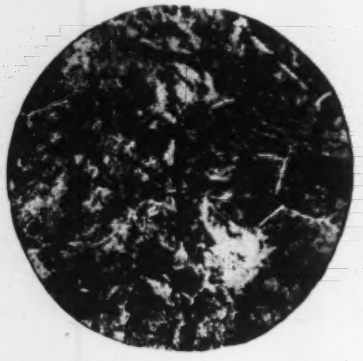


FIG. 3. TRANSVERSE FISSURE IN THE ISER RAIL, CUTTING ACROSS ALL GRAINS
Magnified 100 diameters

FIG. 4. STRUCTURE OF STEEL IN HEAD OF ISER RAIL, SHOWING DISTORTION OF GRAINS AT TOP FACE AND UNIFORM STRUCTURE IN CENTER OF HEAD
Magnified 100 diameters

Mr. Wickhorst's conclusion is in part based on the observation that more fissure failures occur in the second rail from the top of the ingot than in any other. In part it is based on the following:

> When examined chemically, fissured rails have shown a tendency toward hardness. The carbon is generally above 0.70% and frequently above 0.75 or 0.80%. The rails with compound fissures seem generally to show interior segregation of carbon, phosphorus and sulphur, but those with simple transverse fissures have usually shown a fairly even distribution of the elements, as determined by a comparison of samples from the corner and the interior of the head.
>
> When examined physically, the rails have generally shown good physical properties in the different parts of the rail section, except in the interior of the head, where the ductility has usually been low and frequently entirely absent. When examined for small cracks by a process of etching and highly polishing, fissured rails have also shown numerous small cracks in the interior of the head; that is, the metal inside the head was in a generally torn condition. The investigations have not, however, as yet shown to what extent this was an original condition of the rail as made and to what extent it developed in service.

While making no mention of injury to rails by the gag press, Mr. Wickhorst considers the question of track stresses. These stresses he appears to regard as a contributory but minor cause of rail breakage. The two following passages tend in this direction, though they oppose each other in a measure:

> Transverse fissures are most numerous in rails from the upper part of the ingot, but when examined by the usual chemical methods they are generally free from much segregation. These types of failure (split heads, transverse fissures and compound fissures) are the results of growth under repeated strains, and the age of the rail at the time of failure would be a function of the wheel loads and number of wheels passing over the rail, as well as of the rail section and interior condition of the rail.
>
> It has sometimes been stated that rails break because they are too light and that, therefore, their weight should be increased, including the weight of the head. There is of course an advantage in heavy rail as regards smooth-riding track and ease of maintenance, but the weight of the rail can be considered only a minor factor as regards head failures. The primary cause of head failures must be considered to be a defective internal condition. This would not be bettered by an increase of weight, nor would the strength of the rail to resist head failure be materially increased by an increase in the weight of the head.

A New Test for Rails: The Quick-Bend Test

An important change in rail specification is foreshadowed by the fact that a quick-bend test for rails, as a substitute for the drop test now universally employed, is being considered jointly by the Rail Committee of the association and the rail manufacturers.

The committee's report states that the principal advantages of the quick-bend test are in giving information regarding the elasticity of the steel and making it possible to determine the ductility more definitely. On the other hand, it is probably inferior to the drop test as a test of brittleness. The quick-bend test has been investigated with great thoroughness on the Pennsylvania R.R., tests being conducted at its Altoona shops, and the report is accompanied by a paper on this subject by W. C. Cushing.

As long ago as 1907 one of the steel manufacturers objected to the drop test as being much more severe than any blow received by rails in service and not indicating those qualities of the metal that it would be most desirable to know in connection with the acceptance or rejection of the rails. Later study indicated that with brittle material inside the head, but covered with tougher material on the outside, the real character of the rail may not be developed by the drop test.

Advantages of the New Test Over the Drop Test

It had been found that the drop test did not give consistent results, as the deflection and blows required to break the modern heavy rails did not accord with what would normally be expected. The quick-bend tests were made in a hydraulic forging press equipped to permit taking indicator cards showing the pressures and corresponding deflections. These tests gave more consistent results. Other tests were made by the Illinois Steel

Co. in a Riehlé testing machine, and the relations of elongation to permanent set were found to check very closely with the corresponding data from the quick-bend test.

The Pennsylvania R.R. committee reported that the quick-bend test gives more definite determination of the ductility, as it is possible to make a precise study of the relation existing between the deflections and loads at points between elastic-limit load and ultimate load. It appeared also that the quick-bend test is a means of securing more durable steel with the proper toughness.

Tentative specifications for the quick-bend test have been prepared as a supplement to the rail specifications of the Pennsylvania R.R. and are based on the 125-lb. rail of that system. They provide that the machine shall be a horizontal hydraulic press of not less than 350 tons' capacity, with the supports for test specimens spaced 48 in. between bearing points. The press must have a hydraulic indicator so connected that the pressure on the head of the ram is registered by the pen on a vertical scale while the distance rotated by the cylinder is proportional to the travel of the ram head. The speed of the ram is to be about 13 ft. per min., when allowed free travel.

The rail specimens are 4½ to 6 ft. long, cut from the top end of the top rail of the ingot, and tested at a temperature of 60 to 120° F. The specimen is placed with the center mark of its head under the fulcrum point of the ram and then subjected to pressure until rupture occurs, an indicator card being taken at the same time. The requirements as to results are as follows:

Elasticity or Stiffness Test—The load at elastic limit shall not be less than 140,000 lb. for test specimens having a deflection at ultimate load of 3.65 in. or over, nor less than 205,000 lb. for test specimens having a deflection at ultimate load of 2.5 in. For any test specimen the product of the elastic-limit load multiplied by the corresponding deflection at ultimate load shall not be less than 512,500 pounds.

Ductility or Toughness Test—The deflection at ultimate load for any test specimen shall be not less than 2.5 in.; and when less than 3.65 in., it shall be so related to the elastic-limit load that it will satisfy the above equation.

Opinions on Need for Sub-Base Show Startling Diversity

Replies to Questionnaire of Universal Portland Cement Co. Are Often "Yes" and "No" on Same Question

WHILE the replies from engineers in various parts of the country to a series of questions sent out by the Universal Portland Cement Co. show a remarkable variation in opinion and practice, most of it may be traced to peculiarities of local conditions. The following eight questions were asked: (1) Is the cost of a sub-base justifiable? (2) Does its use facilitate drainage? If so, to what degree? (3) Is it of value when used on heavy clay subgrades? If so, what thickness is most desirable? (4) What should be the maximum and minimum thicknesses? (5) What quality and kind of material are preferable? (6) Should the sub-base be rolled and tamped? (7) Have any of your observations indicated that a sub-base increases or reduces the injurious effects of frost action? (8) Can you point out any advantages or disadvantages not suggested?

Majority Oppose Sub-Base

The numerical preponderance of the negative answers to the first question, "Is the cost of a sub-base justifiable?" is somewhat bewildering in light of the fact that men of such prominence as J. H. Weatherford, city engineer of Memphis, Tenn., and W. H. Connell, who has just resigned as chief of the Bureau of Highways, Philadelphia, take the opposing view. Between the opinion held by these two engineers and the categorical "No" that represents the majority opinion, are found many like C. H. Nye, city engineer of New Bedford, Mass., who states that each case must be determined on its merits; and E. H. Rogers, city engineer of Newton, Mass., who is of the opinion that money spent on a sub-base is well spent when the pavement is laid on a subsoil which retains water that may freeze; and W. M. Barclay, former city engineer, Kansas City, Mo., who does not use a sub-base, but did not state whether or no he had ever given it a fair trial.

But with the difference of opinion as to the desirability of a subgrade, there is uniformity as to the necessity for adequate drainage for the water that may accumulate in the subgrade. E. L. McLane, city engineer of Hutchinson, Kan., states that his reason for opposing the use of a sub-base is that it creates a reservoir, while on the other hand, A. Lenderink, city engineer of Kalamazoo, Mich., gives approximately the same reason for using some porous material under a concrete wearing surface. However, F. L. Ford, city engineer, New Haven, Conn., implies that the provision of a sub-base automatically takes care of drainage, in which position he is in accord with J. A. Jones, city engineer of Lewiston, Maine, who, however, makes the qualifying statement that a sub-base "keeps water from under pavements." C. D. Kercel, city engineer, Janesville, Wis., uses a sub-base construction only as an aid in obtaining a true grade.

Besides a difference in qualitative opinions, there is a remarkable variation in estimates of how much of a sub-base is necessary on heavy clay. From the irreducible minimum of no thickness whatsoever, estimates run as high as 15 in., this last being the maximum estimate of J. G. Thorne, city engineer, Clinton, Iowa, though the general opinion, when a sub-base is thought desirable, indicates a thickness between 4 and 8 in.

Any Cheap Porous Material Suitable

That almost any material, if it be porous and cheap, is suitable for a sub-base, is the general consensus. While some—J. A. Gehres, city engineer, Akron, Ohio, for instance—seem to think that the material should be screened to remove the finer particles, on the other hand, George Randall, city engineer, Oshkosh, Wis., recommends the use of sand or fine gravel. As a rule, however, any sort of broken stone, cinders, slag or similar material is held to be satisfactory.

With the exception of F. Cunningham, Sullivan, Ind., there is remarkable agreement as to whether or not the sub-base material should be rolled. However, Mr. Cunningham's answers to the eight questions are uniformly "No."

To question 7, "Have any of your observations indicated that a sub-base increases or reduces injurious ef-

fects of frost action?" more definite and more classifiable answers should be expected. Six of the 85 answers are "No," which would indicate that observations had afforded no criterion of judgment. Forty-one answers expressed absolutely no opinion, and five indicated that, unless provision is made to remove the water accumulated in the sub-base, the destructive action of frost is increased. Of the remainder, the majority seemed to feel that the effect of frost is reduced by the use of a sub-base.

In answering question 8—whether any advantages or disadvantages not suggested accrue from the use of a base—John Wilson, consulting engineer, Duluth, Min suggests that the use of a base may tend to decrea friction between the pavement and the subgrade, but he unable to say definitely whether this is desirable or n and E. G. Orbet, civil engineer, West Allis, Wis., and F. Harper, city engineer, East St. Louis, Ill., feel th the use of a sub-base is detrimental to the concrete, inasmuch as it absorbs water from the mass before hard ening takes place.

Weak Flat-Slab Concrete Building Strengthened by Adding New Steel and Wood Frame

Dangerous Sagging Due to Poor Design Remedied by Enlarging Columns, Placing Steel Floor-Beams and Wooden Floors

By MAURICE C. COUCHOT
Civil Engineer, San Francisco, Calif.

THE Blinn Estate Building in San Francisco, a six-story reinforced-concrete warehouse of the flat-slab type, began to show signs of serious weakness soon after its completion in 1912. These defects increased with time, until early in 1916 it became necessary to make very radical repairs, primarily to prevent total failure of the structure, but also to keep the tenants to their lease. The weakness of the original design and the methods of making repairs both give interest to the operations.

The building, general details of which are shown herewith, is divided into nearly square panels of 16 ft. by 16 ft. 3 in. except for the bay over the spur track parallel to 2d St., which is 20 x 16 ft. The floors were supposed to be designed for a live-load of 250 lb. per sq.ft., which is in accordance with the Building Ordinance of the City and County of San Francisco for warehouses of this kind. A flat-slab system was used for the floor construction with a slab 6 in. thick, including the finish, and with no drop panels above the capitals of the columns. The cap had a uniform size 4 ft. 6 in. square at the under side of the slab, finishing as an octagon to the column shaft and having a uniform slope of 45°. The columns are octagonal throughout the building.

Soon after completion the building was occupied by the tenants. Their attention was immediately directed to structural defects in the building. These defects became more and more noticeable as time went on. Fearing that the structure was not safe and that a failure might occur which would cause a loss of life and property, they notified the owners of what was taking place and at the same time called in C. H. Snyder, a consulting engineer, to make an examination of the structure and report upon its safety. The writer was consulted by the owners and after making his report was instructed to prepare plans to make the structure safe and able to carry the required load.

How the Building Had Failed

An examination of the structure and plans showed the following conditions: The floor slabs throughout the building had sagged from 1 in. to 5 in., and there was a characteristic crack around the edge of the column caps, from which other cracks also radiated. Similar conditions existed around the caps of the wall columns, and the wall was found to be pulling away from the slab. The building was in such bad condition that temporary wooden shoring was immediately placed.

The columns showed no physical weakness, although they were not designed heavy enough for the assumed load and therefore were greatly overstressed. This does not mean that the columns were stronger than theory would show them to be, but is accounted for by the extremely light load that they supported. The wall footings, although incorrectly designed, did not show any failure, probably because the building rests on a rock foundation. Otherwise, the eccentricity of loading would have caused them to settle on one edge.

In comparing the slab design to a cantilever flat slab of the same size panel and thickness, it was found that the correct number of bars was used in the diagonal bands, but the rectangular bands consisted of five $\frac{1}{2}$-in. square bars, where nine $\frac{1}{2}$-in. square bars were required. The worst feature of the entire design and the cause of most of the trouble was the absence and inefficiency of negative reinforcing steel at the column head. The detail calls for the bars of the rectangular bands to extend 6 in. into the column cap; none of them extend across it. Alternate bars of the diagonal bands bend up at the column capital and extend across it; the other bars were cut off at the edge of the rectangular band. It was a wonder that the slab was able to hold itself up with the steel placed in this manner.

Method of Making Repairs

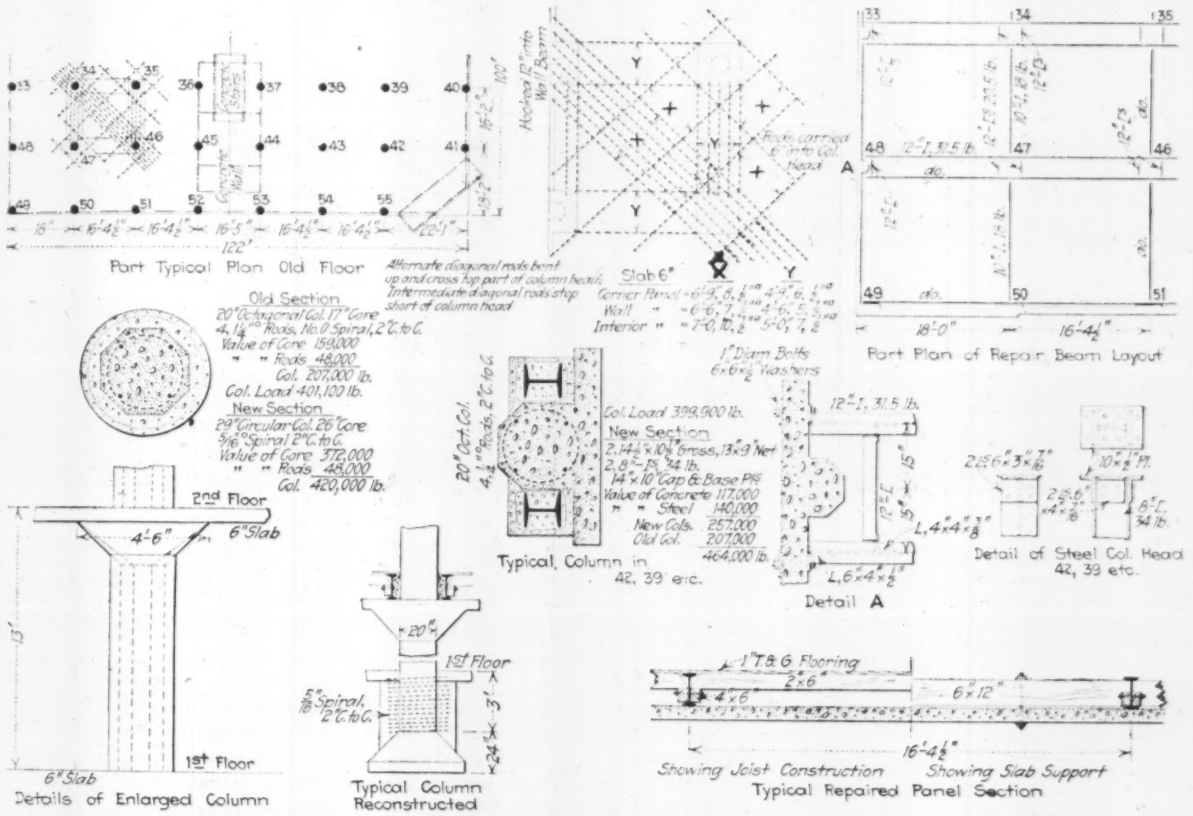
The first scheme considered for the repair work was to use the old slabs as forms on which to build the new, but the added weight would have required columns of too great a size and an alteration of the foundation. There was also the danger of damaging the goods on the lower floors while placing the concrete, and the inconvenience to the tenants of having the shores, water, dust, etc. Also, the length of time before the falsework could be removed precluded the use of this method, which would have been adopted had the building been vacant. It was then decided to use the system described below, as it is the lightest, the quickest to erect, the cheapest

and the one causing the least inconvenience to all parties concerned.

The reconstruction consisted of increasing the strength of the concrete columns and the construction of a new frame of structural-steel beams to support the old floor, the new floor and the superimposed live-load. The old concrete columns were wound with a continuous spiral of No. 0 wire, spaced at the required pitch and distance from the old column face. Concrete was then built out from the old face to the required thickness with the cement gun. For the first-floor columns next the wide bay, I-beams incased in concrete were used to increase the section.

The new floor system consisted of 12-in. 31.5-lb. I-beams 2 ft. 6 in. c. to c. straddling the columns in one a great amount of inconvenience owing to the limited amount of space that could be worked on at one time.

The designing of a building of this kind is criminal. No excuse can be given for the detailing of the steel reinforcement as shown on the plans. It is the work of a man who was obviously not competent to carry out this sort of work. The Building Department of the Board of Public Works at the time these plans were made did not have an engineer upon its force to examine the plans and determine whether they were properly designed. The writer does not look upon this building as a failure of reinforced concrete, but considers that it shows that reinforced concrete, even under the adverse conditions imposed upon it in this building, shows a remarkable strength, as in one instance—in the third floor—a panel



FLAT-SLAB FLOOR WHICH CRACKED UNDER SERVICE REPAIRED BY PLACING NEW FRAME

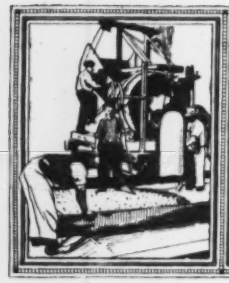
direction, with another line of 10 in. I-beams at right angles to these, completely tying the system. Around the columns the space inside the beams was filled with concrete, and at the walls the steel frame was anchored by large bolts and washers. Wooden 4 x 6-in. pieces were set on edge on the lower flange of the I-beams and bolted to the webs with $\frac{3}{8}$-in. bolts, 12 in. on centers. On these 4 x 6-in. pieces a solid flooring of 2 x 6's laid on edge and spiked together formed a subfloor, on which an Oregon pine wearing surface was placed. The old concrete slab was supported by four rods with washers, which were fastened to 6 x 12-in. timbers supported by the new steel frame. This was done to prevent the slab from settling any more, due to its own weight.

In doing this work it was of first importance that the tenants be disturbed as little as possible, which caused was loaded to the extent of 18 tons, consisting of linoleum and window-shade material.

The repair cost of this building was $33,000, while the first cost was $70,000.

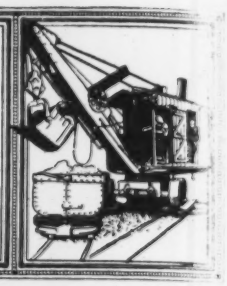
Water Power in France

Two considerable water-power developments are under way in France, brought about by the need of munitions and facilities to make them, combined with the scarcity of coal. There is one installation of 20,000 hp. using water from the Alps in control of one corporation. Another development of 50,000 hp. is in the Southwest and uses water from the lakes and rivers of the Pyrenees Mountains. Before 1914 factories were very scarce in that region, whereas now there are many works engaged in making munitions.



HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK



Points in Tremie Operation Developed on Troy Guide Walls

IN THE construction of the crib foundations of the guide walls of the Troy lock on the Hudson River some subaqueous cribs were filled with concrete through a tremie. Some valuable experience found there is told by John J. McCabe, junior engineer, United States Engineering Department, in a recent issue of "Professional Memoirs."

When first used, the tremie was hung between two pontoons from a heavy frame carrying the hopper into which the concrete was discharged, the frame operated by block and tackle leading to a hand winch on the pontoon. Three different lengths of pipe were used, the longest about 22 ft., shorter sections replacing the longer as the concrete was brought up. This rig was cumbersome, slow and difficult of operation and very often allowed the charge of concrete in the pipe to get away before the pipe could be lowered quickly enough to check the flow.

Nearly half the concrete in the cribs was placed with this rig; but as soon as the derrick boat was available, only the longest length of pipe was used by hanging it directly from the hopper, which was surrounded by a working platform, the whole swung from the derrick boom. The pipe filled with concrete was easily and quickly raised and lowered by the derrick, with no time lost for changing pipe lengths.

The concrete for filling the cribs was a 1:3:6 mix, with enough water to make a mushy mass, but not enough to cause water to collect at the top while standing in the hopper. To prevent the initial charge in dropping through the water, a gunny sack was stuffed with straw and rammed into the top of the pipe. The concrete was then lowered onto it, forcing it down slowly. When the sack reached the bottom, it freed itself automatically and floated to the surface. This method proved quite satisfactory.

The first concrete poured through the pipe was made about as stiff as that placed in open forms; but it would not only fail to flow away from the pipe into the surrounding area of the cribs, but on two occasions it arched and some of it stuck in the upper part of the pipe, while the lower portion dropped to the bottom, causing a vacuum that collapsed the pipe as flat as if it had been run through a train of rolls.

The matter of the consistency of the mix greatly affected the speed of placing the concrete, the fairly soft mix being easy to get through the pipe quickly and continuously, moving more evenly away from the end of the pipe and not washing like the drier mix; and it seemed to stick in a mass better under water and resisted percolation by the agitated water beyond the outer film of mortar.

Mixer Stretches Road Reinforcing Behind Itself Automatically

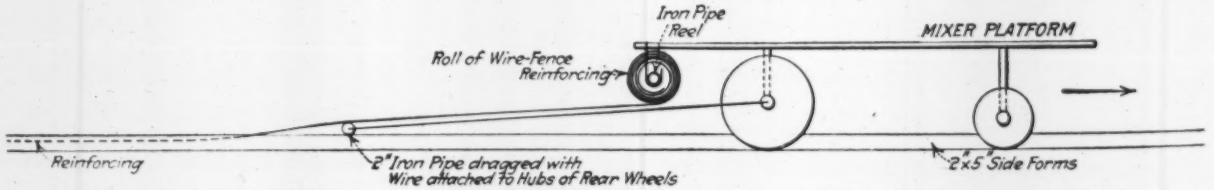
By J. M. OAKEY

City Engineer, San Bernardino, Calif.

THE SCHEME shown in the accompanying sketch was used to eliminate considerable work formerly required for unrolling, raising and stretching the wire fencing used in reinforcing some concrete roads across boggy ground in San Bernardino County, California.

MIXER LAYS AND STRETCHES ITS OWN REINFORCING

The pavement on the stretches of road referred to is 16 ft. wide and 5 in. thick, and three widths of 60-in. wire fencing were used for reinforcing. The plan devised for handling it, which proved quite effective, was to run an iron pipe, to be used as a reel, through the center of the three rolls of reinforcing and hang the pipe on hooks attached to the floor of the mixer. Another pipe was placed under the reinforcing and on top of the side forms of the pavement, keeping the reinforcing off the ground. This pipe was dragged behind the mixer by wires tied to the hubs of the rear wheels and was adjusted so as


Iron Pipe Reel
MIXER PLATFORM
Roll of Wire-Fence Reinforcing
Reinforcing
2" Iron Pipe dragged with Wire attached to Hubs of Rear Wheels
2"x5" Side Forms

UNROLLED FROM PIPE REEL, WIRE FENCING USED TO REINFORCE CONCRETE ROAD IS HELD TIGHT AND KEPT AT RIGHT ELEVATION BY ROLLER ON TOP OF FORM

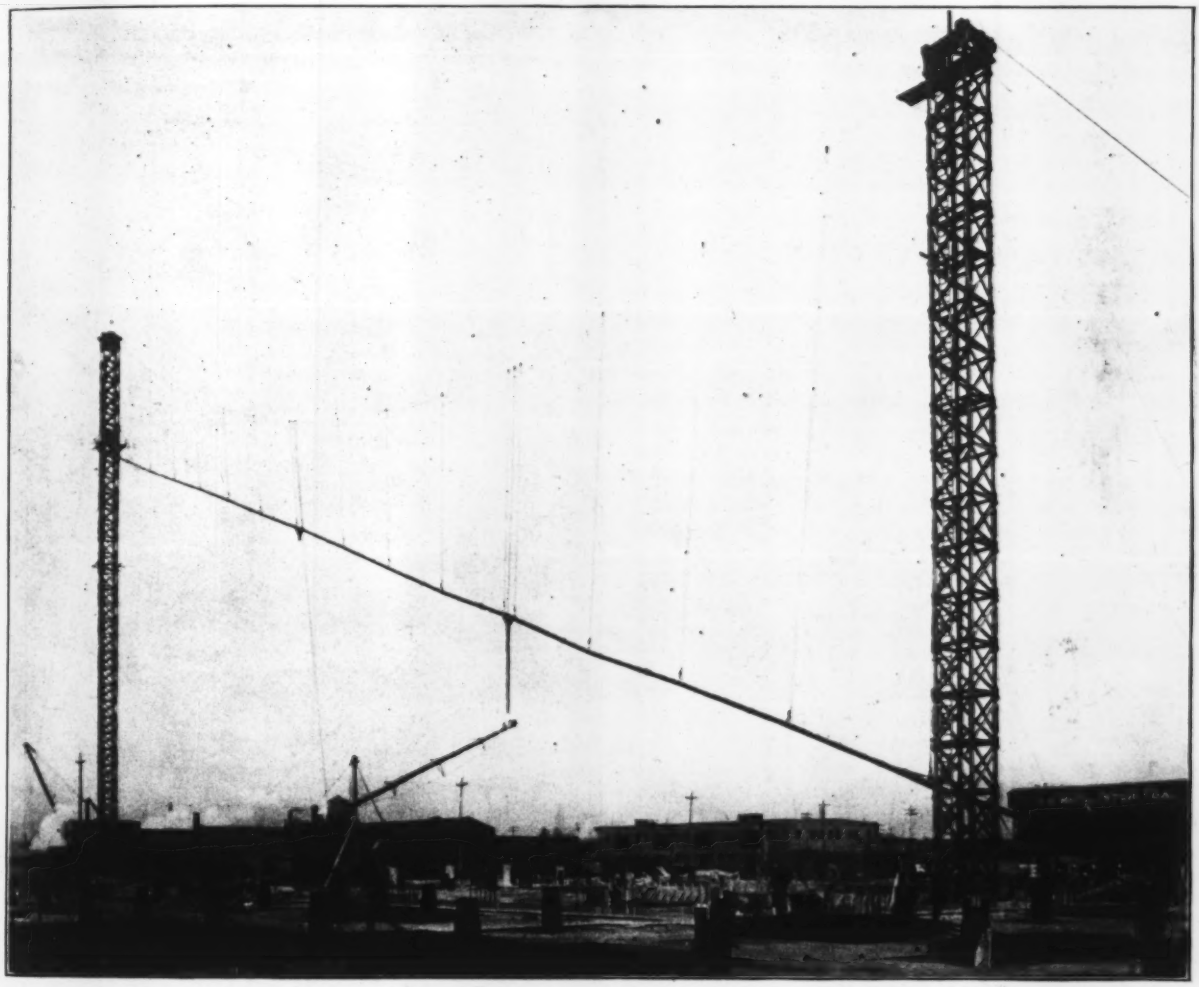
to stay just ahead of the concrete spout. Thus as the mixer moved ahead, the reinforcing was automatically unrolled, stretched, and held at a fixed distance off the ground by the pipe laid on the forms.

Four-Hundred-and-Sixty-Foot Chute Line Strung Between Tall Towers

AN UNUSUALLY lofty spouting plant, with a primary chute 460 ft. long, is being used by William Steele & Sons Co., of Philadelphia, in constructing a reinforced-concrete building in that city for B. S. & F. W. Fleischer, Inc. The main tower is 240 ft. and the tail tower 120 ft. in height. Concrete is distributed to various points in the building, which is spanned by the long chute, by a secondary set of chutes from two drops, one of which is shown in the photograph. The other will be installed 180 ft. from the main tower.

Concrete materials are received by rail and unloaded by a derrick with a clamshell bucket into bins over the mixer. The plant, which is of Insley design, is operated with a 36-cu.ft. bucket and a 45-cu.ft. hopper at the top of the tower.

The work is in charge of K. J. Lundelius, engineer for the contractors.



LONG CHUTE, WITH TWO DROPS, DISTRIBUTES CONCRETE FOR LARGE BUILDING AFTER 240-FT. HOIST

Use Pier Form as Inside Cofferdam

By KIRBY D. MACLEAN
Seattle

THE PIER-SHAFT form was set under water and did double duty as inside cofferdam and concrete form in constructing the shaft of the pier for the Division St. bridge in Spokane, the unusual cofferdam for which was described on p. 414 of *Engineering News-Record* last week.

The cofferdam had been sealed under water, and two layers of bracing, which had been required during the driving of the sheeting and the placing of the seal, were then removed. This work was done by a diver, taking out the crossbraces but leaving the tie-rods in place. The form for the pier shaft, which was built of 2 x 8-in. tongue and groove sheeting, placed vertically, was stood up in the cofferdam, brought to line and well braced inside with the help of the diver. The cost of this form exceeded by a surprisingly small amount that of similar work done in the open.

The extra width of the cofferdam and the batter of the pier left a space 28 in. wide at the top and 16 in. wide at the bottom between the outside of the form and the piles. Around this space, about a foot of concrete was deposited

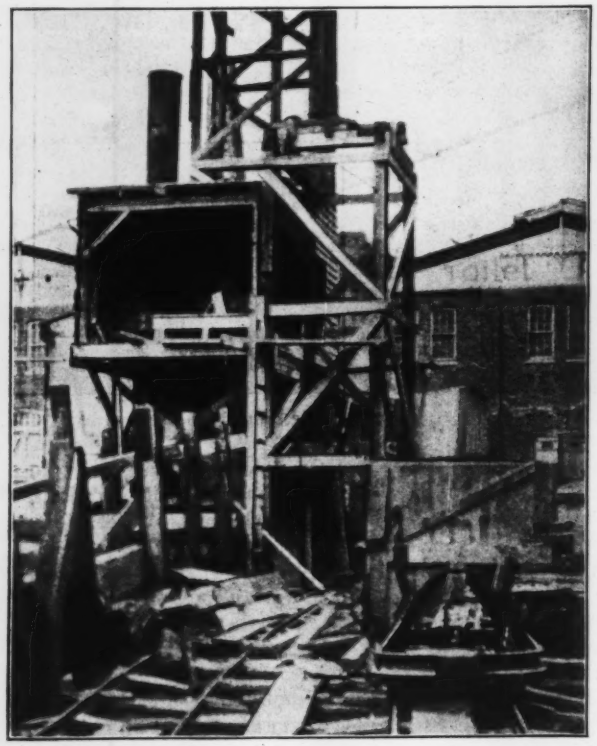
under water, sealing any leaks between the concrete and the bottom of the form. This space was then carefully puddled with a mixture of gravel, clay and manure, gravel being used to save the clay, which was expensive. This formed a puddle-wall cofferdam for practically the cost of a single line of sheeting, plus the cost of placing the puddle material. Having tongue and groove walls on both sides, the dam proved very tight. The method also saved considerable time, the initial time for constructing the cofferdam being much less than if it had been made with two rows of sheeting, and the form and puddle work being carried out while the concrete seal was setting, which time would have been lost.

A pump was put inside the form, the space unwatered and the seal concrete carefully cleaned. The bracing inside the form was taken out as the pier concrete came up.

The work was done under the direction of the writer as engineer and general superintendent of construction on the Division St. and Olive St. bridges in Spokane.

Car Elevator Supplies Concrete Plant Set on Receiving Dock

IN BUILDING extensions to the plant of the Scott Paper Co., at Chester, Penn., the concrete spouting plant was located near the shore end of an existing L-shaped pier to take advantage of water delivery of materials. The aggregate was unloaded at the outer end of the pier and carried to the concreting plant at the level of the deck in cars made by constructing wood bodies on old dump-car frames. To get this material into gravity charging bins over the mixer without setting up a second derrick or building a trestle at high level, the contractor set up a light builder's elevator for raising the small cars to the desired level. On top of the charging bin there was a hinged apron which was thrown over by hand against the car frame as the elevator reached the top, so that when the car dumped, there would be no spill. The elevator was operated by a line from the hoist.

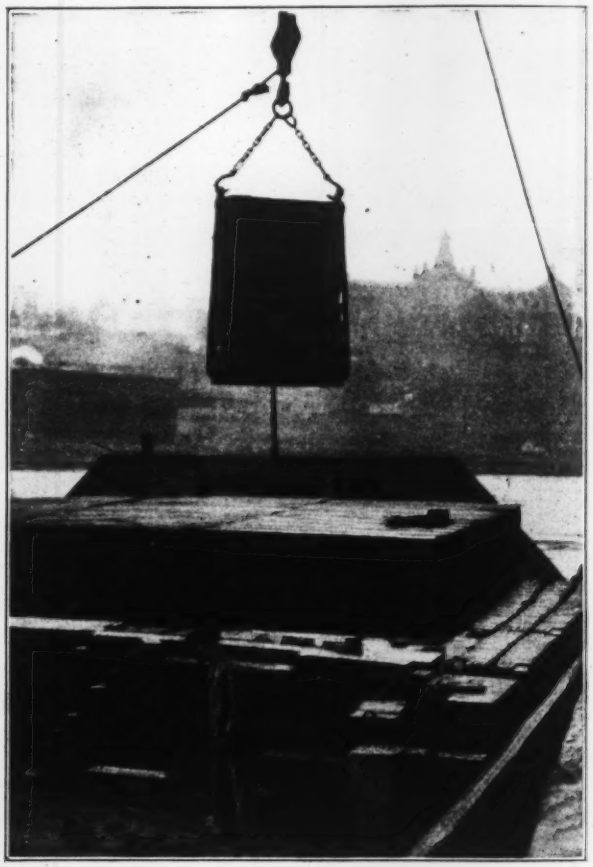


SMALL ELEVATOR COSTS LESS TO RUN THAN EXTRA DERRICK

The buildings under construction are being completed by W. J. Cummings, contractor, of Philadelphia.

Hoisting Racks Speed Unloading of Blocks

RAPID loading of automobile trucks with asphalt paving blocks is being accomplished by the Hastings Pavement Co. at a dock in the Harlem River, New York City, as shown in the accompanying photograph. The blocks are loaded by hand on the racks. When the barge has been unloaded beyond reach of the derrick used to hoist these racks and drop the blocks on the automobile truck, the racks are rolled down the deck of the barge on small four-wheeled trucks, as shown.



RACKS HASTEN LOADING OF TRUCKS

In this way it is possible for a few laborers to have eight racks, which make one truck-load, full by the time each successive truck reaches the dock, so that only a very short time is required to fill the truck. It is understood that, where such blocks, or brick, have had to be passed up by hand and loaded, it has been found that the use of automobile trucks is unprofitable, because of the length of time they are held at the dock for loading.

EDITORIALS

Camp Building Needs Army Engineers

THIS journal, in its issue of May 24, urged an early recognition of the fundamental engineering nature of the work of building the 32 camp cities to house our new army. Since then one step toward that end has been taken. A board of consulting engineers and contractors has been appointed, with vaguely defined powers, to aid the Quartermaster Department of the army in the design and construction of the camps. The second necessity—a closer coöperation between the Quartermaster and the Engineer Corps of the Army—seems still short of accomplishment. The Quartermaster's Department has always had charge of camps and barracks construction and has in its normal personnel a certain number of officers and trained civilian engineers especially qualified to take charge of building work. But the problem of the new cantonments is larger than mere army-camp building; it is city building, it is engineering of the highest sort, a job with which the more broadly trained Corps of Engineers is well fitted to cope and above all a job which would find much needed assistance in the new Engineer Officers' Reserve, particularly in Class B, which is made up of men who did not volunteer to lead troops. Will not the stress of need break down army departmental friction and enable the country to have the benefit of the experience of the real engineers now in the service of the army for this work, which has been characterized by a leading Washington official as "the greatest task now before the American people"? The Corps of Engineers has the men, the Quartermaster's Department has the work. Will they get together?

Standing Pat on Cast-Iron Pipe Specifications

THE stand-pat attitude of manufacturers of cast-iron pipe, brought to light at the Richmond convention of the American Water-Works Association, was deplorable. After blocking, for a year, progress by the joint committee on cast-iron pipe specifications of the American and New England water-works associations, a representative of the manufacturers went so far as to oppose sending the tentative draft of the joint standard specifications to the membership. Instead, he urged a letter ballot, "sight unseen," on whether the members wished any change at all in the 1908 specifications. The absurdity of such a request is equaled only by its audacity. The creation and continuance of the committee show that a revision of the specifications is demanded by the buyers and users of pipe. Moreover, there is also a demand for a single set of cast-iron pipe specifications for both associations, instead of two "standard" specifications. As soon as that demand was in a fair way to be met by the joint committee of the two associations, the pipe makers first objected, then balked, making further progress impossible without giving up all attempt at coöperation between the pipe users and makers. If the pipe makers decline even to suggest changes in the tentative draft, then the two thousand members of the American and New England water-works associations should know all about this "deadlock by courtesy" and see for themselves, and without delay, the tentative specifications. Accordingly, *Engineering-News-Record* prints the tentative draft in full (page 449), prefaced by an abstract of the committee report submitted at Richmond. It now remains for the members of the two associations to say whether they prefer two "standard" specifications or one.

No Extended Debate Necessary

LAST WEEK, *Engineering News-Record* pointed out the need for utility managers and commissions to meet the war emergency by acting quickly on urgent questions. At Washington the Interstate Commerce Commission is hearing arguments for and against the application of the railroads for a 15% rate increase. The proceedings sound much like those of other years and suggest that the commission has not yet adjusted itself to the new conditions. They suggest also that the right hand of the Government does not know what the left hand is doing. Precise determination of whether the 15% increase asked by the railroads is more reasonable than 10 or 20% would take much investigation, but there is hardly time for that now. When the Adamson law was passed last summer, it was rather definitely implied that the carriers would be allowed to make up the increased expense by higher rates. A liberal allowance for that should be made. Also before and since this law was passed, prices have been going up—prices of everything a railroad buys. If there were no war, the railroads should be allowed to meet these increased prices. Because there is a war, it is doubly important that they be allowed to do so, so there will be no disturbance of their credit when so much depends on their efficiency. The Interstate Commerce Commission should act quickly and leave precise calculations to normal times.

What Higher Rates Would Cost the Public

FOUR CENTS a week per family is what the Pennsylvania R.R. estimates that the 15% freight-rate increase sought by the railroads would cost. This is based on a family of five at Pittsburgh. The figures are for food only, and *Engineering News-Record* will not vouch for their accuracy. We are convinced, however, that the fears of so many that increased freight charges would pile heavy additional burdens on a people already staggering under war-time prices is largely unfounded. If higher rates would mean much higher prices, it might be reasonable to ask the railroads to consider decreased profits or increased deficits, as the case might be, in the nature of war sacrifices. But since this does not appear to be the case, it is far more important that the transportation business be stimulated to do its best—especially in view of the President's near-promise of last September.

Construction Work Needs Quick Organizing Thought

Our Government announces that business will be intense, but a business of necessities, and speaks of three to five years of war. Engineering and construction are vital necessities. Mere maintenance cannot serve for such a period. To plan rightly, for both maintenance and construction, demands prompt application of high organizing skill.

CABINET officers and men of the National Defense Council's Advisory Commission spoke last Friday to the industrial element of the nation, represented by the editors of technical and business journals. Their prime message was that our industrial life must and will be rebuilt to serve the needs of making war—and those needs alone. They declared that business will be intensely active, but that it will be transformed into a business of necessities.

Engineering and construction are so largely, almost so exclusively, concerned with necessities that without question intense activity will prevail in these fields. In a war that is called an engineering war, the engineering is only in small part needed in the field; that which is done back home is the determining element. And this engineering back home is not merely the making of shells and rifles. It is just as much the development of railroads to maximum efficiency of service, for carrying grain and guns.

Maintenance, rigid and economical maintenance, seems to be the first lesson to be learned. And in this field, it is true, we are almost at the threshold of learning. If, as was said at Washington, we as a people must learn thrift, must acquire new habits of close economy, must learn the doctrine of the clean platter, must save out of the earnings of the early future the seven billions of dollars that are being borrowed, then it is clear that immediately we must exalt maintenance to a high place and make it always the ally of construction.

But much more was said at Washington. The production of luxuries, trading in luxuries, will be disorganized. "It *ought* to be disorganized," said one of the strongest of those men. Styles may be standardized. Women and youths will be drawn into production very largely. The habits of the people will be remodeled. We must prepare and reform ourselves most completely, for we must face three to five years of war, said the government's representatives.

It is on a long-time basis, then, that we must prepare. And if this is so, then all our plans must be on a permanent basis. *Makeshifts and temporizing must be abandoned at the very start. We must plan for and engage upon a fixed, steady course of development.*

Dependence on maintenance would be fatal under these conditions. Patching the boiler and crowding the furnace in the hope of reaching port before trouble comes would be direct invitation to disaster. Our work, our development, must be replanned to the new purposes and ideals, and its execution must then be taken in hand at once and pushed forward progressively.

The first strain of this new burden comes on those who have to plan—on engineers—as well as on legislators and administrators of private or public works. Already this strain has brought them into some confusion.

Many retrenchment ideas developed some weeks ago have already been characterized as hysteria and panic. But the notion still survives that complete stoppage of construction is necessary and desirable—as tiding us over a short war period successfully. Let those who have followed this line of thought confront with courage and foresight the need of planning for from three to five years of war, and they will be bound to make a sudden shift in their plan of action.

With this crude notion of repressive economy overcome, however, the first phase of the serious problem is to be faced. Sanely and carefully, a decision must be reached as to what work is work of necessity. We see distinctly that just now all railway development which adds to capacity or to early wealth-producing power is necessary—everything connected with transportation, freight terminals, storage and car supply. That modernization of passenger stations may well be deferred is just as clear. But in the matter of scheduling passenger trains, apparently a closely related matter, it is hard indeed to make a sound decision and very easy to make an unsound one. Very many other questions are equally complex and difficult.

In road transportation, construction of pleasure drives is easily ruled out. But who will decide offhand a question of market-road improvement? We have to balance the economy of three-year maintenance against more thoroughgoing improvement, but also we must estimate the traffic results obtained. It takes only a small difference in road condition to make a difference of quite a few percent. in the encouragement to the flow of food supplies, and the Department of Agriculture tells us that this year we will be dealing with single percents in the feeding problem!

Just as in these type instances, railways and roads, so the engineer will find himself confronted by perplexing queries in every phase of his work. He must make his decisions on the basis of broadest-gage economics.

Even bigger is the second phase of difficulty, however. Our methods of dealing with construction work must adapt themselves promptly to the new situation as it develops from day to day. They have not yet done so, and losses have resulted. To avoid further losses and the creation of handicaps for the future requires speedy revision of methods.

Work cannot be planned, estimated and bid upon by old conventional methods in a period of mounting prices, uncertain deliveries, a labor market lacking all stability, and general doubt as to how much the actions of the national administration will affect contractors. These radically new conditions do not permit fixed and unchangeable design, for one thing. Again, they do not countenance narrow limitation of bid figures to a small

percentage above an advance estimate. Contractors can not afford to stake their all against the chances of labor shortage, of interrupted supply of materials, of delay or ruin by slow deliveries and enhanced prices. In short, construction work cannot be undertaken, and certainly cannot be carried through successfully, unless wholly new methods are developed either by the engineers or by engineers and contractors jointly. The season's program of work has already been jeopardized, but quick action based on high-grade organizing thought can yet save the day.

The national Government has not hesitated to abandon standard methods. It has gone almost wholesale into the practice of letting work without competitive bidding. Where work had to be done and time was a factor, the best man at hand was set to work on cost-and-profit basis. Disregarding details, the main fact is that methods of getting work done were adjusted with all speed to the new conditions.

Engineers and public-works men must use like originality. They must go even farther. Their designs must be flexible, ready for radical change in the field. Their specifications must drop the rigid defining clauses hitherto used, and instead must treat the contractor as a necessary partner, not as a defaulting debtor. Time limits are apt to hurt rather than help the work—they will need to be dropped, or else handled in a new coöperative spirit.

The labor and material-supply difficulty is the core of the problem, however. The engineer and the public authority must help the contractor in mastering it, if they want to attain success. Price allowances for changing rates of pay and cost of materials can help over one part of the difficulty. But the methods used at Washington suggest another solution of the problem. Pools or rings of contractors may be formed, to get the best joint effect of plant and materials as well as to make most efficient use of the total available labor. Even further, the entire construction work of a district—of a county, or several counties, or perhaps an entire state, can be joined in common interest, and operations controlled from a central office. A semipublic construction organization of great size may thus be created, embodying in most complete form the three-sided partnership of public, engineers and contractors. Under its management, for example, there would be no danger of having a dozen jobs left half-completed when materials or labor run short, for the central office, by diverting the limited supply to the points of greatest need, would secure for all parties the most efficient result that the circumstances permit.

To summarize the case briefly: Radically new lines of thought must be followed, and this effort must initiate with the engineer. The conditions affecting construction work are unprecedented, and may develop in new ways from day to day. Throughout all changes, the engineer must rise to the level of events.

Steel Mills and Bridge Shops To the Front

THE verdict of the strongest minds is for steel vessels as our shipping salvation. General Goethals' declaration, on May 25, brings with it a host of new problems. The magnitude of the task set by the decision puts a prime burden on the steel-plate mills and on the bridge shops. They will have to roll the plate and punch and shape the frames and sheathing ready for erection.

For months plate has been short. Evidently, production must now be driven to an unprecedented pitch if a wholly new demand of surpassing magnitude is superadded to the prior demands. The steel manufacturers will be ready to do their part.

Bridge-shop methods must be used if the shipbuilding program shall go along at maximum speed. The pace that prevailed in shipyards hitherto will necessarily have to be quickened. Mass-production methods have had little chance. But with standardized ship design, made inevitable by the size of the present problem, it will prove possible to substitute rapid, repetitive shop methods for the individual-ship methods of the yards.

Existing bridge shops are the agencies by which the early phases of the work will need to be handled; the erection and equipping of special shops can hardly be awaited. All the intimations from Washington are to the effect that time is the essence of the ship-construction need. And this can mean only one thing: While new tools—new ship shops—are being shaped for service, other hands must set to work doing as much as can be done with the existing tools. The bridge shops are the most capacious tools for the purpose that we possess.

A fine test this will be for American adaptability and resource! The test will be met successfully, of course.

Readjustments of many kinds will be needed in the shops. Turning to a wholly new class of work is in itself a strain, but on top of this will come the strain of keying up to maximum production, in just the same degree as machine shops have done for half a dozen years past under the pressure of the high-output drive for efficiency of manufacture. In this process the bridge shops doubtless will clean up the last vestiges of tradition and dogmatism, of which they have never wholly freed themselves.

That the lines of readjustment can be laid down with final correctness from the start is hardly to be expected. Readjustment will thus be a continuing process. It will be long before ideas crystallize to form definite, approved standards. This is clear from the evolution which the past few weeks have brought.

Thoughts and conceptions have been clashing violently. Three weeks ago we were carried along on the shimmering wave of the wooden-ship project. Not until a few days later did some powerfully warning voices of dissent make themselves heard. Even on the day the last issue of *Engineering News-Record* went to press, May 23, the new government newspaper, *The Official Bulletin*, told of a great organizing movement to get apprentices "in the yards in which the great fleet of wooden vessels will be constructed." And forty-eight hours afterward, General Goethals dashed the wooden-ship project to atoms. He has left nothing fixed but the certainty that steel production and shop fabrication must be the great agencies to work the ship problem out.

In such a contest of intellect and administration as that just passed through, the forces involved are too great to come to rest in a moment. The first adjustment can hardly be the final one. Early orders may need to be countermanded or modified. Yet the minimum of delay and lost progress must result.

Construction Notes from an Army Training Camp

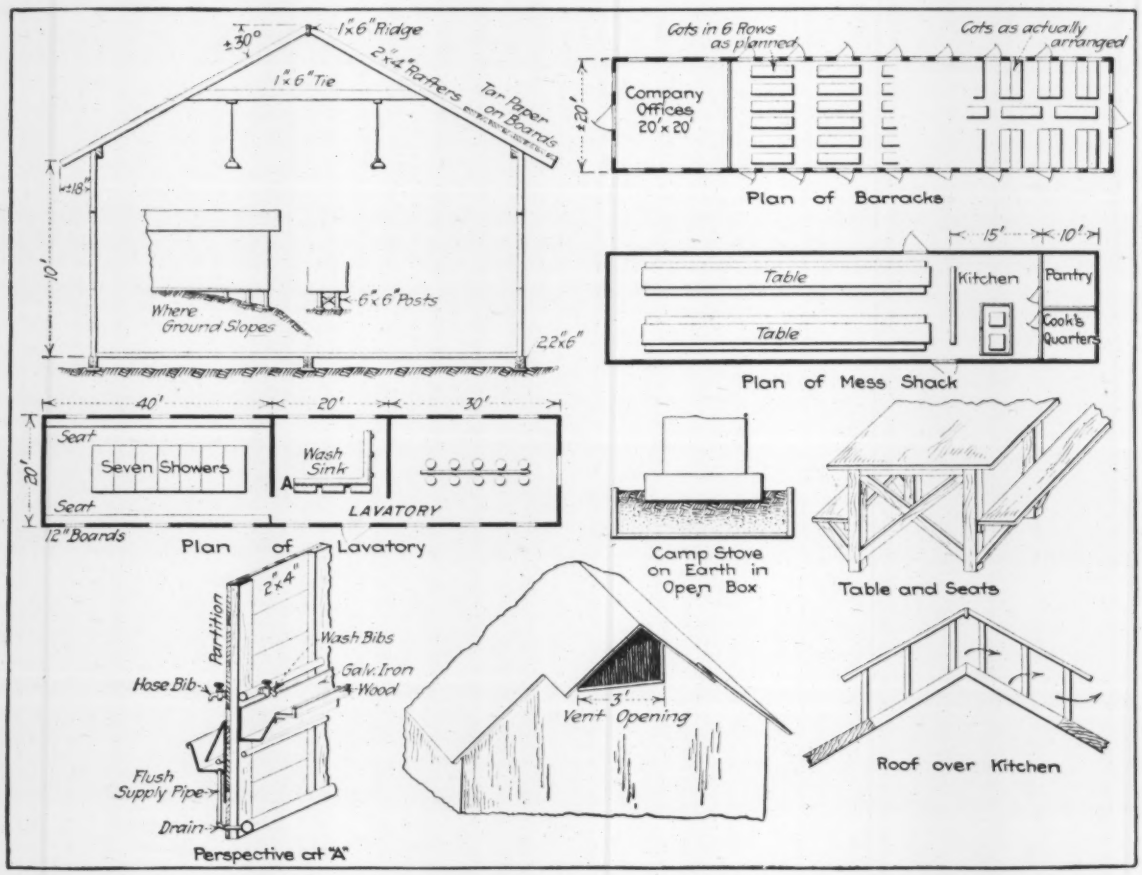
Sketch Details Given for Wooden Barracks, Washrooms and Mess Shacks—Roadbuilding Important

AS A PRELIMINARY step to the assembling and training of the army of 500,000 men which will be created by the passage of the draft bill by Congress last week, a building-construction program on a vast scale becomes necessary. Present indications point to the establishment of 32 divisional camps, each one, in fact, a city with a population of thousands. The immediate job that confronts the War Department, therefore, is the provision of housing facilities for the men—sleeping barracks, mess halls, lecture rooms, amusement halls, etc.

Already a number of camp buildings have been rushed to completion to accommodate candidates for the Officers' Reserve Corps during their period of training this summer. Judging by the type of the structures built, timber barracks of simple design will be the standard. The accompanying sketches indicate a few of the building details at camps now occupied as reserve-officers' schools.

The first work at camp sites is the laying out of the buildings. Road construction becomes the next order of business. It is understood that a single contract for binder material on roads near all camps is to be let to a large concern manufacturing bituminous products, which has developed an organization, countrywide in scope, for handling roadbuilding work and has offered its services to the Quartermaster Department of the army. This company, so the rumor goes, will probably act as a clearing house for other companies doing roadwork. It is probable that payment for roadbuilding will be on the basis of cost plus 10%.

The wood cantonments thus far constructed have followed designs previously used at mobilization camps, although it is understood that improvements are being planned by the Quartermaster Department. All the plumbing fixtures have been standardized by agreement of



THE NEWER CAMP BUILDINGS ARE, IN MANY DETAILS, IMPROVEMENTS OVER THOSE ERECTED FOR THE MEXICAN BORDER MOBILIZATION

manufacturers throughout the country. As in the roadwork, a single company is said to have been selected to act as a clearing house in apportioning orders to makers of fittings.

According to the observations of a civilian who visited one of the camp sites, the bath and toilet buildings are excellent and show that special attention has been paid to sanitation. Valuable lessons have been learned from the buildings erected on the Mexican border for the use of troops during the recent mobilization. In plan these buildings are about 20 x 60 ft. The floors are of concrete or wood, with slopes and drains—a big improvement over the Border buildings.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Women Draftsmen Would Release Men for More Arduous Work

Sir—Allow me to suggest through your columns that a good many men might be released, at this time of national necessity, to other departments of activity of a more arduous and exacting nature, if women were induced to enter the field of drafting. A large percentage of this work is purely a matter of routine and could be turned over to women, who, as a whole, should perform such work more quickly and with greater accuracy and neatness than the average male draftsman.

The prospective salary they would earn at such work, the fact that it would take no lengthy or elaborate preparation to equip them to perform a large proportion of it and the fact that they would work under environment excelling those of clerks, stenographers, etc., should offer no mean attractions.

Further, the advent of women in this capacity into the offices of engineers and architects would in due time add features of economy, simplicity and beauty to structures that have hitherto remained undeveloped.

C. E. Newell,
Washington, D. C. Southern Railway Company.

Car-Mounted Guns as a Means of Coast Defense

Sir—In the Apr. 26 issue, page 204, you give an account of car-mounted guns for coast defense. Briefly I would like to give what may be called a little side history in connection with this idea. In 1910 I published a short article advocating the construction of a military railway along the Pacific Coast with specially designed cars for coast defense. The plans for the railway and cars were roughly sketched and sent to the War Department, where they are peacefully reposing today.

In those days a civilian knew only of ordinary cannons, and the cars were simply designed. To steady them on being fired, jack arms were to be used on the same principle as on a steam shovel. Later I requested the War Department to at least acknowledge my claim for suggesting a railroad seacoast battery. They replied "nothing doing," that cannons had been fired from cars in the Civil and Franco-Prussian Wars. This settled the matter as far as I was concerned, as it is a waste of time to get into a discussion with the government. I did not claim any novelty in firing cannons from cars, but for the particular use as a seacoast battery mounted on a railway designed for that special purpose.

The difficult part of this problem is not to design special cars, but to get the Congress to make an appropriation for the construction of the military railway. The idea of a railroad coast defense battery I did not seek to patent; it was given freely without strings of any kind on it. Had the War Department seen fit to take up and develop the idea they would naturally have arrived at substantially the same design as the Luellen-Dawson cars, and no patent rights of any kind would be involved.

This is the coming means of coast defense, as forts excepting at a few points are obsolete. This is a land navy, and its maneuvers should be carried out in conjunction with the movements of the navy at sea, as these land batteries could reinforce our navy in any engagement within ten miles of our coast.

Renton, Wash. F. W. Harris.

City Engineer Appoints City-Planning Superintendent at Rochester

Sir—The article and editorial in your issue of May 3, regarding city engineers and city planning, interested me greatly. For some time we have been considering this relationship of the city engineer to city planning, in connection with a study of possible legislation in the City of Rochester. In the majority of cases it appears that the city engineer has very limited powers as to the city plan. His legal status has not been defined clearly; and on this account, as well as for other obvious reasons, he has not taken the active part in city planning for which his training apparently should fit him.

Recent legislation affecting the City of Rochester tends to place direct responsibility for developing and carrying out a city plan upon the city engineer. An act amending the charter of the city has recently been passed by the legislature and in due time will become law. There is created in the Engineering Department of the city a City-Planning Bureau, headed by a superintendent to be appointed by and hold office at the pleasure of the city engineer. In addition to this Bureau and superintendent, there is provided an Advisory Board, consisting of four members, to be appointed by the mayor, and the corporation counsel, ex officio. This board is to act in an advisory capacity with regard to all matters concerning the city plan.

The superintendent of city planning has power under the new law to develop a city plan; to prepare a city map; to pass upon all subdivision work involving the opening, widening or extension of streets; to establish building zones, and to restrict building to conform thereto. His actions must be approved by the Advisory Board, and it is provided that in the development of the general plan he shall avail himself of the services of competent consultants. The joint action of the superintendent of city planning and the advisory board are subject to review by the mayor, who is empowered to hold public hearings whenever desirable or proposed by the advisory board or the superintendent, and who also has the power of absolute veto after such hearings have been held.

This legislation is intended to correct some of the most obvious defects found in most city-planning legislation. The most glaring fault has been the organization of city-planning commissions, which have consisted almost exclusively of lay members against whom the criticism is often made that they are interested chiefly in developing civic centers and "works of art." These commissions usually have failed to carry into effect the city plan, even where they have developed one, and generally have fallen short in most of the routine, details regarding subdivision

work, street widening, extensions, etc. In other words, the usual form of city-planning commission has lacked an executive with power to initiate and carry out a constructive policy. It is believed that the new legislation for Rochester has remedied this defect.

JAMES W. ROUTH,
Chief Engineer Rochester Bureau
of Municipal Research.

Rochester, N. Y.

Prefers Batter on Front of Curb

Sir—In *Engineering Record* of Mar. 10 is a short article by E. P. Arneson in which he shows a section of concrete curb construction.

The batter of his curb is placed on the back. A curb with a batter on the front is, I believe, more desirable than a straight-faced curb. Where the batter is on the front it keeps the rim of motor vehicles from coming in contact with the top edge of the curb, as is the case with a straight-faced curb. The crown of the pavement throws the wheel slightly out of perpendicular, causing the rim to come in contact with the curb, which adds to the wear of both and which would be avoided if the front side of the curb was given a slight batter.

I also call attention to the fact that curbs which are integral in construction with the pavement proper are becoming more and more used and are a most desirable form of construction from almost every viewpoint.

A. W. JOHNSON,
Consulting Highway Engineer,
Portland Cement Association.

Chicago, Ill.

Nomenclature Committee Considers Symbols for Engineering Formulas

Sir—A letter from R. Fleming, on p. 102 of the April 12 number of *Engineering News-Record*, brings up again the question of uniform symbols in engineering formulas. This is a question that has often been debated by engineers and engineering teachers. About twenty years ago several committees of the Society for the Promotion of Engineering Education wrestled with the problem, and a number of lists of symbols were proposed. None was ever definitely approved by the Society.

An examination of the Proceedings indicates that a majority of those interested were in favor of a standard list of symbols, though a few eminent gentlemen opposed the idea vigorously. Evidently no list could command a majority vote, and the matter ended in reams of discussion, without definite action.

For some years a committee of the Society for the Promotion of Engineering Education has been working on the Standardization of Technical Nomenclature. While its reports up to this time have not considered standard symbols, the committee has been urged to prepare such symbols at each of the annual meetings at which its reports have been discussed. In pursuance of instructions given to it, this committee is now preparing a short list of symbols of some of the important concepts in mechanics.

It is not difficult to prepare a list of symbols, but it is extremely difficult to secure acceptance of such a list. Authors of textbooks in mechanics, and instructors who teach that subject in our universities, are the ones who are responsible for the present situation. These are the men who must be brought into line if a list of symbols is to become standard. Accordingly the committee has written to fifty professors of mechanics, many of them authors, asking them to prepare lists. Up to date fourteen lists have been received and these are being charted and tabulated. When all the returns are in, a list will be made up of those symbols that appear oftenest in the lists that are received, and this will be presented at the next meeting of the Society for the Promotion of Engineering Education in June, 1917. Whatever be the action taken with regard to it by the society, it appears evident that such a list will be of interest to future writers on mechanics.

The committee of the Society for the Promotion of Engineering Education is fortunate in having the cooperation of committees from many of the leading engineering societies of this country, who will consider and discuss the list before it is formally presented. It is hoped thus to ascertain the objections to the list of symbols, and meet them, satisfactorily, if possible. The list will therefore have careful revision by different groups of engineers.

JOHN T. FAIG,
Chairman, Committee on Standardization
of Technical Nomenclature, S. P. E. E.
University of Cincinnati, Cincinnati, Ohio.

Municipal Ownership City in Canada Reports Its Earnings

Sir—For your information below you will find a statement showing the earnings of the utilities of the City of Edmonton, Canada, for the year ending Dec. 31, 1916:

UTILITIES STATEMENT FOR 1916

	Surplus on Operation and Maintenance	Surplus Over All Charges Including Depreciation
Electric light and power	$196,255.16	$64,788.82
Water-works	173,220.90	24,410.04
Telephone	167,965.95	9,570.84
Power house (up to June 30, 1916)	119,468.34	39,430.71
Street railway	132,755.88	119,597.66 deficit
	$789,666.23	$138,200.41
		119,597.66 deficit
Surplus over all charges on all utilities		$18,602.75

The above figures speak for themselves. It will be noted that, taking the utilities as one corporation, they show a surplus of $789,666.23 over and above operation and maintenance expenses, and a surplus of $18,602.75.

In this connection it may be pointed out that a private corporation does not lay aside what is known under municipal ownership as a sinking fund, to retire debentures at the end of a certain number of years. It would be sufficient for a private corporation to pay to its shareholders a moderate rate of interest on their shares and lay aside a certain amount for future contingencies, but utilities operated by a municipal corporation are not only required to pay all operating, maintenance and depreciation charges and interest, but are also compelled to put aside a large sum of money each year into the sinking fund, for the redemption of the capital moneys invested, which is no doubt the safe thing to do, but when comparing municipal ownership with private ownership, this fact should be borne in mind.

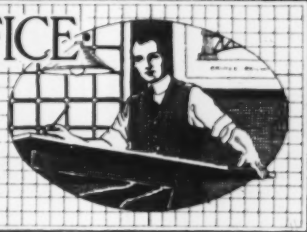
The street railway has a surplus of $132,755.88, 4½% on the capital invested, and showed a betterment of $16,161.05 over the year 1915, which is considered satisfactory.

A. G. HARRISON,
City Commissioner.

Edmonton, Canada.

THE ENGINEER IN FIELD AND OFFICE

A DEPARTMENT
DEVOTED TO DETAILS OF THE DAY'S WORK



Defective Concrete Columns Repaired with Simple Apparatus

By J. D. EVANS
Omaha, Neb.

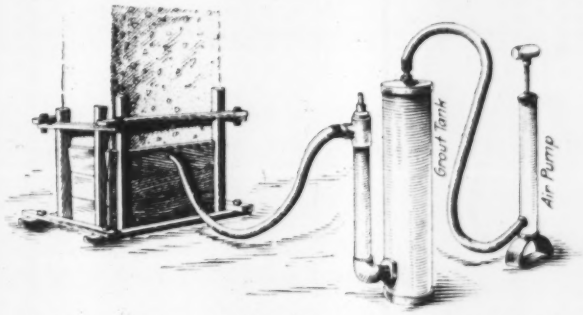
Too dry a concrete, not puddled enough, was undoubtedly the cause of the condition shown in the photograph. These columns, 15 ft. high and 20 in. square, were reinforced with eight 1¼-in. rods bound with spiral reinforcement. A satisfactory repair was made in the following manner:

The concrete was cut off level and a wood form placed around the bottom of the column—the top board leaning out so as to form a hopper—and a piece of ½-in. pipe was put in at the high point of the cut, extending from the center of the column out through the form. A fine gravel concrete was put into the hopper, thoroughly rammed and allowed to set for about two weeks. The forms were removed, and the patched part was trimmed to conform with the rest of the column.

The voids in the repaired portion of the column were then filled with pure cement grout forced in through the pipe by a compressed-air apparatus made from a piece of 3-in. water spout, the top being sealed and having a valve

MANY COLUMNS NO BETTER THAN THIS WERE REPAIRED SATISFACTORILY

from an automobile tire set in the center, as shown in the drawing. The bottom was sealed also. From near the base a smaller pipe extended to about the top of the tank. After the grout had been poured in, this was connected by an air-tight line to the pipe cast in the column. By the use of an automobile-tire pump, the grout was forced into the voids. After pumping for some little time, water could be seen seeping out on the sides of the columns, showing that the scheme was working out satisfactorily.



GROUT FORCED INTO SHRINKAGE VOIDS WITH EXTEMPORIZED APPARATUS

Several buckets of grout were forced into a few columns and undoubtedly filled all voids due to the shrinkage of the concrete.

Pusher and Momentum Grades for Railroads —Why Not for Highways?

By S. C. REDD
County Engineer, Greenlee County, Arizona

BOTH momentum and pusher grades are used in railway location and are found economical. If they are allowed in railway work, they surely are justified in highway work, since it is well known that horses can exert twice their average effort for short distances and since all motor vehicles have gear shifts. Considering motor vehicles only, momentum grades would be short stretches, perhaps not over 200 or 300 ft. in length, where the momentum would carry the vehicle over the extra grade without shifts of the gears, while pusher grades would be longer stretches requiring a gear shift.

It has been the general policy in and around Arizona to set the maximum grade at 6%. Some long grades have been built to this maximum, sometimes encountering very costly work because of an unwillingness to exceed 6% under any circumstances. There is no intention of discrediting high standards in road construction, but only to urge an intelligent use of those standards. In Greenlee County, Arizona, the endeavor is to maintain a ruling grade of 6%, but 8% and sometimes as high as 10% grades have been used for very short distances in avoiding cliffs and bad turns—the extra expense of maintaining these higher grades and the supposed danger contingent to traveling on them having been considered fully. Frequently the use of the higher grade so shortens the distance and straightens the line that it is neither as expensive to maintain nor as dangerous as the line with the lighter grade.

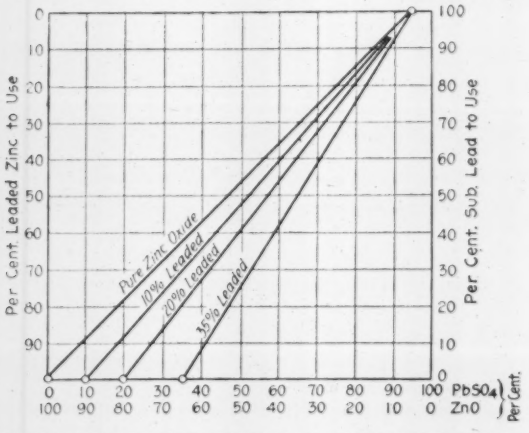
When a grade exceeding the set maximum is thought advisable, an estimate is made of what the line would have cost if the regular ruling grade had been maintained. The effect of the higher grade on the traffic is then observed, and in no instance has there been cause to regret the choice of the higher grade. For instance, there are two 9% grades about 1000 ft. long, each one of which cost less than $800; but had 6% grades been used, the expense would have been in excess of $3000 in each case. If the traffic is not more than 30 or 40 vehicles per day, to have held rigidly to the established maximum would have been to exercise poor engineering.

For similar reasons the radius of curvature may be decreased, but never so low as to interfere with the easy manipulation of vehicles at slow speeds. Changing the standard of width or finish is, of course, a far more delicate matter—it should be lowered only in extreme cases, if at all. Narrowing the clearway is apt to be the cause of serious accident to passing vehicles, as well as an inconvenience, and there are few cases where any very heavy extra expense is incurred in maintaining the standard of surface.

How to Increase the Lead Content of a Leaded Zinc Paint

IN STATES requiring the formula to be shown on paint packages, the lead content of all oxides excepting the lowest (under 5%) must be stated. In all cases where the lead sulphate is actually basic ($Pb_3S_2O_8$), this is properly given as "basic lead sulphate." On the other hand, if leaded oxide be used in which the lead content is practically all present as normal lead sulphate ($PbSO_4$), the propriety of the designation may be subject to question.

In practice it is often necessary or desirable to increase the basic lead sulphate content of the formula over that present in the leaded zinc available for use. Since basic lead


Per Cent Leaded Zinc to Use
Per Cent. Sub. Lead to Use
Pure Zinc Oxide
10% Leaded
20% Leaded
35% Leaded
0 10 20 30 40 50 60 70 80 90 100 PbSO4 Per Cent.
100 90 80 70 60 50 40 30 20 10 0 ZnO

AMOUNTS OF LEADED ZINC AND SUBLIMED LEAD TO USE FOR DESIRED LEAD CONTENT OF MIX

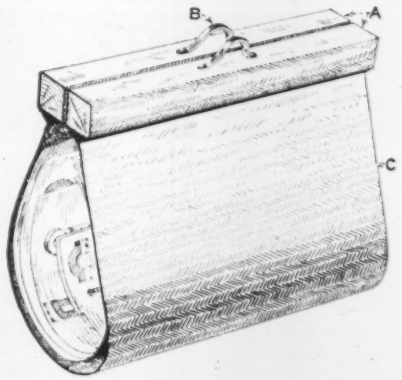
sulphate (or sublimed lead) as marketed contains about 5% of zinc oxide, calculation of the required proportions of the two pigments required to yield the relative percentages is a rather complicated process. The chart by J. E. Heckel will furnish the required information at a glance:

The figures to the left indicate the percentages of leaded zinc and those to the right of sublimed lead required to produce the required percentages of ZnO and $PbSO_4$ indicated at the bottom of the chart. The four diagonal lines represent the several grades of oxide. To find any desired percentages shown in the bottom rows of figures, using any of the oxides shown, follow the perpendicular line to its intersection with the proper diagonal; the required percentages of that oxide and sublimed lead will then be found on the horizontal line to the left and right respectively. For example: Desired percentages 50 each, using a 35% leaded oxide. The 50-50 perpendicular intersects the 35% diagonal at the horizontal line, which indicates at the left 76% leaded zinc, and at the right 24% sublimed white lead. The desired percentages will therefore be obtained by using 76 lb. of the former to 24 lb. of the latter.

Make This to Carry Your Drawings

By F. E. POTTER

It is customary for drafting rooms to place their drawings, either every night or once a week, in a vault for safe keeping. The device shown in the illustration has proved



A CONVENIENCE—AND TAKES UP NO ROOM

satisfactory for carrying the drawings. It is easy to make, two pieces of white pine *A*, 37 x 1¼ x ¾ in., two black japanned door pulls *B*, and one piece of unbleached cloth *C*, 37 x 30 in., being fastened together in the manner shown. If desired, a small hook and eye may be attached at each end of the wood crosspieces to hold them together and prevent the loss of drawings when the carry-all is laid down.

Why Brass Pipe Fails

Failure in brass pipe when used for house plumbing is usually due to improper or incomplete mixture in making the pipe, according to Charles A. Finley, managing engineer, Bureau of Water, Pittsburgh, Penn., in a report to the Board of Trade Committee on City Water. The failure and breaking down of the pipe are usually galvanic or electrolytic in nature. The part played by the water is simply that of a solvent, all water being more or less of a solvent. Copper, zinc and lead are generally used in the manufacture of brass pipe. They represent differences of electrical potential. If the mixture is not complete and homogeneous, this difference of electrical potential in conjunction with the water in the pipe sets up an electrolytic or galvanic action which results in the removal of the zinc or lead from the body of the pipe. The

zinc or lead, as a metallic salt, is either carried away or deposited, leaving the body of the pipe in a porous condition. The detecting of defective brass piping, before it is used, is a difficult matter requiring chemical analyses and microscopic examination at the hands of one who must practically be an expert in this line.

Using Concrete Floor Forms as Base of Permanent Flooring

ON THE new reinforced-concrete factory for the Westinghouse Lamp Co., being built at Trenton, N. J., by Stone & Webster, the wooden forms for the flat-slab floors are put to permanent use as the subfloor carrying the matched maple factory flooring. The top of the concrete floor is rough-finished below grade and finished by subsequent concreting around the usual spaced screeds. On these screeds are spiked as a fairly tight subfloor the rough boards used for the floor forms next above, which can readily be taken down from the ceiling. The matched maple flooring is then fastened directly to the form-timber floor.

Tar Makes Creosote Treatment Erratic

An inspection of piling installed at Gulfport, Mississippi and Pensacola, Florida, at various time since 1910, showed that the pieces treated with straight coal-tar creosote and high-boiling creosote fractions IV and V were still in excellent condition, according to reports from the Forest Products Laboratory. Those treated with high-boiling water-gas-tar creosote were also in good condition, but those treated with the lighter water-gas-tar oils showed marked signs of failure. Piling treated with wood-tar creosotes from both hard and soft woods was badly attacked. Specimens treated with an iron acetate solution were practically destroyed. Piling treated with creosote containing a metal, such as iron or copper in solution, was in better condition than that treated with creosote alone. Creosote to which crude naphthalene was added did not protect the specimens as well as the plain creosote oil. The addition of tar to the oil appeared to be of some slight benefit so far as the protection was concerned, but the penetrations were much more erratic and the result was localized attack on the wood.

Relocate Columns of Old Philadelphia Subway Without Disturbing Roof

THE DESIGN of the new steel for transferring the load from the existing Market St. subway in Philadelphia to the walls of the new Broad St. subway, which passes underneath, avoids disturbing the roof of the former structure on account of changes in the locations of the columns by catching the old columns near the top with double lines of longitudinal girders resting on the new columns. The new columns, of course, are over the walls of the new Broad St. subway. The construction is plainly shown in the photograph.

The new columns and the girders under the roof of the Market St. subway were erected around the existing columns before disturbing the old steel. The columns of the existing subway were then riveted to the girders, as shown in the illustration, and the load transferred to the new columns. The old columns were then burned off at the bottom of the new girders with the oxyacetylene torch. On account of the headroom it would have been difficult to place girders of sufficient weight at or below track level to carry the old columns, and the design adopted therefore avoided the necessity of reconstructing the roof of the Market St. structure.

NEW STEEL DESIGN, WHICH CATCHES COLUMNS JUST BELOW ROOF, AVOIDED DISTURBING LATTER AND PERMITTED EASY ERECTION

NEWS OF THE WEEK

Current Events in the Civil Engineering and Contracting Fields

Urges Engineers To Get Into Political Life

Gardner S. Williams Addresses American Association on Business Engineering

"Your place is in every public assembly at your party caucus and at your county's polls on election day," said Gardner S. Williams to the members of the American Association of Engineers at the third annual convention, held May 13 and 14. Further, he urged the establishment of local organizations, if only in wards, to bring together engineers for the purposes of discussing the questions that agitate or interest the citizenship. "When conclusions are reached, go out and fight for them before the public and let the people know that you are one of 200,000 of the best-trained, most capable citizens of the republic, who is doing his duty by his fellow-man, by his profession and by himself."

The new constitution proposed was not considered, but a new committee, headed by Isham Randolph, was formed to get something with centralized responsibility and authority.

Things accomplished, as reported by the secretary, are as follows: More than 1800 applications for membership have been received, of which about 400 have failed to qualify. About 1200 men have been placed in touch with positions. Members have learned to mix and to speak in public. Applications from 100 engineers to go to Russia have been turned over to the Council of National Defense. The continued Eastern demands for men have been supplied from the West's oversupply. A recruiting station is maintained in the association's office. The society is out of debt. The "Monad" is almost self-sustaining. Little has been done in the way of legislation matters, but the association advocated a bond issue in Chicago, which won out. At Gary, Ind., it inaugurated a post-card campaign to encourage engineers to vote.

A resolution was passed remitting the dues of members enlisting and extending membership privileges without payment of dues to enlisted engineers.

Four Railroad Engineers for France Reach London

The War Department two weeks ago ordered four army engineers to France to determine the precise needs of French railways, for the repair and maintenance of which nine engineering regiments are now being organized in the United States.

This party, which has reached London, consists of William Barclay Parsons and William J. Wilgus, of New York, majors in the reserve corps; W. A. Garrett, of Chicago, vice president of the Chicago Great Western, a reserve officer, and Capt. A. B. Barber, of the regular army engineer corps. They will make recommendations affecting the organization of the railway engineering troops. Captain Barber expects also to study problems of trench construction.

Steel Corporation To Build Standardized Ships

The United States Steel Corporation is preparing to enter the shipbuilding field on a large scale through its subsidiary, the American Bridge Co. Sixty acres of land have been bought in the Hackensack Meadows, on Newark Bay, near Newark, N. J., in a locality where comparatively little dredging will be required to get sufficient depth of water for large freight ships to make their way out through Staten Island Sound to the sea. The plans of the corporation have not been worked out, but it is understood that the management is contemplating the rapid construction of standardized cargo boats running from 5000 to 8000 tons dead weight.

Louisville, Ky., Tackles the Grade-Crossing Problem

A movement for the elimination of grade crossings in the City of Louisville, Ky., has been in progress for some months, and a number of civic and business organizations have taken up the matter. No definite action has resulted from this as yet, but the city's Department of Engineering (D. R. Lyman, Chief Engineer) has already prepared plans for the elimination of grade crossings on 14th St. from the Ohio River to Kentucky St., a distance of 1½ miles. These plans are now under consideration by the Pennsylvania Co. and the Louisville Bridge Co.

North Carolina Borrows Money for Counties

The General Assembly of North Carolina at the session just closed passed "an act to encourage roadbuilding in North Carolina by state aid." This act provides for the creation of a state road fund of $800,000 each year for the next 41 years, which will be loaned at 5% per annum to the counties complying with certain provisions of the law. This rate will pay both interest and principal.

In order that a county may secure such a loan from the state, 25% of the qualified voters must sign a petition, which will be filed with the Board of County Commissioners. The election following this petition must be held within 60 days after its filing.

Geodetic Survey Engineers Available for War

President Is Authorized to Use Personnel and Equipment for Military Purposes

By an act of Congress signed by the President May 22, he may transfer to the services of either the War or the Navy Department the personnel and the equipment of the Coast and Geodetic Survey if in his judgment a national emergency exists to warrant such action.

The President is authorized to appoint the field officers of the Survey, who are now officially designated assistants and aids, as follows: Officers now designated assistants and receiving a salary of $2000 or more shall be appointed hydrographic and geodetic engineeers; officers now designated assistants and receiving a salary of $1200 or more but less than $2000 shall be appointed junior hydrographic and geodetic engineers; officers now designated aids shall be appointed aids.

High Bridge Bids Are Rejected; Will Use Day Labor

All bids recently received for the construction of the piers and abutments for the Key bridge across the Potomac at Washington, D. C., were rejected by Col. William L. Fisk, Corps of Engineers, U. S. A. Five bids were received, and the lowest, that of Thomas Sheehan, Hagerstown, Md., for $328,963, was about $100,000 in excess of the estimate. The work will be done under the supervision of the War Department by day labor, which it is believed will prove more economical.

War Department Needs Govern Federal Aid for Roads

In a letter recently sent out, Secretary of Agriculture Houston states that War Department requirements would be made a part of the previously issued regulations for the handling of Federal aid funds. Some of the rules are as follows:

Roads must have a smooth surface of broken stone, or a pavement not less than 20 ft. in width.

Grades not to exceed 5%, except for short distances (less than 50 yd.), where they shall not exceed 10%.

Bridges must be of iron or masonry and capable of supporting a 6-in. howitzer (3000 lb. on front wheels and 6500 lb. on rear wheels) or a three-ton truck loaded (6000 lb. on front wheels and 8000 lb. on rear wheels).

All road construction must be able to stand as heavy loads as are required of the bridges.

Academy of Engineers Is Before Congress

Bill Authorizes Body To Further Interests of Engineering and Applied Science

There is now before the House of Representatives a resolution (H. R. 4625) empowering 50 engineers, named in the bill, to incorporate as the American Academy of Engineers, who are to investigate, examine, experiment and report upon any subject of engineering science or art, when called upon by any Government department. The bill follows:

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That John W. Alvord, of Illinois; Edward G. Acheson, of New York; Thomas E. Brown, of New York; Louis Bell, of Massachusetts; L. H. Backeland, of New York; C. F. Chandler, of New York; John F. Coleman, of Louisiana; Howard E. Coffin, of Michigan; John J. Carty, of New York; Mortimer E. Cooley, of Michigan; William F. Durand, of California; Gustave J. Fiebeger, of New York; George W. Goethals, of New York; W. F. M. Goss, of Illinois; Carl E. Grunsky, of California; Robert S. Griffin, of the District of Columbia; Carl Hering, of Pennsylvania; Clemens Herschel, of New York; H. F. Hodges, of the District of Columbia; Henry M. Howe, of New York; John Hays Hammond, of New York; Alexander C. Humphreys, of New York; Hennen Jennings, of the District of Columbia; Julian Kennedy, of Pennsylvania; Hunter McDonald, of Tennessee; C. O. Mailloux, of New York; Charles T. Main, of Massachusetts; Bruno V. Nordbert, of Wisconsin; William H. Nichols, of New York; William Barclay Parsons, of New York; Corydon T. Purdy, of New York; M. I. Pupin, of New York; Charles F. Rand, of New York; Samuel Rea, of Pennsylvania; Rossiter W. Raymond, of New York; E. W. Rice, Jr., of New York; S. W. Stratton, of the District of Columbia; George F. Swain, of Massachusetts; E. Gybbon Spilsbury, of New York; Ambrose Swasey, of Ohio; Frank J. Sprague, of New York; A. N. Talbot, of Illinois; Stevenson Taylor, of New York; Benjamin B. Thayer, of New York; Elihu Thomson, of Massachusetts; David W. Taylor, of the District of Columbia; F. E. Turneaure, of Wisconsin; M. C. Whitaker, of New York; J. A. L. Waddell, of Missouri; John F. Wallace, of New York; their associates and successors duly chosen, are hereby incorporated, constituted and declared to be a body corporate of the District of Columbia, by the name of the American Academy of Engineers.

"Sect. 2. That the purposes of this corporation are and shall be the furtherance of the interests of engineering, industrial technology and applied science.

"Sect. 3. That the American Academy of Engineers shall consist of not more than two hundred regular members, and the said corporation hereby constituted shall have power to adopt a constitution, and to make all by-laws, rules and regulations not inconsistent with law that may be necessary or expedient in order to accomplish the purposes of its creation; to fill all vacancies created by death, resignation or otherwise; to provide for the election of foreign and domestic members, and the division of such members into classes; to adopt a seal, and to do all other matters needful or usual in such institutions.

"Sect. 5. That the American Academy of Engineers shall, whenever called upon by any department or establishment of the Government, investigate, examine, experiment and report upon any subject of engineering, science or art, the actual expenses of such investigations, examinations, experiments and reports to be paid from appropriations which may be made for the purpose; but neither the academy, as a body, nor any of its committees, shall receive any compensation whatever for any service to the Government of the United States."

St. Paul To Lay Block Pavements by Day Labor

The council of the City of St. Paul, Minn., has rejected bids for paving five streets with creosoted wood block totaling 122,000 sq.yd. and has ordered the city engineer to do the work by force account. While the contractors' bid on four of these jobs was less than the engineer's estimate, the fact that the city engineer on last year's work had made an average saving of 7% on his estimated cost induced this action.

After rejecting these bids the council accepted the bid of the Republic Creosoting Co., to furnish 3½-in. creosoted wood block, 14-lb. treatment, pure creosote oil, at $1.67 per sq.yd., f.o.b. St. Paul. Bids were also accepted on portland cement, delivered on street, at $2.38 per bbl., gross. The bids received on the creosoted wood block were as follows: Republic Creosoting Co., $1.67 per sq.yd.; Kettle River Co., $1.67½ per sq.yd.; Ayer & Lord Tie Co., $1.70 per sq.yd.; Central Creosoting Co., $1.71 per sq.yd.

Labor Shortage Delays Grade-Crossing Elimination

F. D. Richards, acting city engineer, recommended postponement of the $2,100,000 Pennsylvania R.R. grade-crossing elimination project at Cleveland, notwithstanding that the city has funds in hand for its share of the work. In the opinion of Mr. Richards, there are two reasons for postponement. One of these is a possible danger attending work of this character in war times, and the other is the difficulty of obtaining labor required for an improvement of this magnitude. Voters authorized bonds for the improvement more than two years ago. Grade crossings from Central Ave. to Holton Ave., S. E., inclusive, are affected.

Pacific Coast Engineer Regiment Near Completion

San Francisco, Los Angeles, San Diego, Seattle and Portland Show Their Patriotism

The Eighth Reserve Engineers has been recruited to more than half strength, and within another week the lists will probably be filled and closed. Recruiting is under way at San Francisco, Seattle, Portland, Los Angeles and San Diego. The San Francisco office has been continually crowded with applicants, and a highly patriotic spirit is manifest. Many who were accepted as privates or first-class privates had given up responsible engineering positions, being willing to go in any capacity whatever. Recently, the net enlistment rate at San Francisco has been about 40 per day—this being about one-third the total applications received. One battalion is being formed in the Northwest, and the other will be outfitted at the Presidio in San Francisco. The mobilization for the State of Washington is set for June 1. After a very brief training period the men expect to proceed directly to the front.

Students To Assist in Army Survey

Sophomores in civil engineering, University of Washington, Seattle, will spend six weeks of the summer working at the survey of the Government's tract of 150 square miles in the region of American Lake. The work will be done in conjunction with the engineering corps of the army and will be a part of the regular summer fieldwork that is required of all sophomores in civil engineering. The party will be in charge of J. W. Miller, assistant professor of civil engineering, and W. E. Duckering, instructor in civil engineering.

Wants Power Site Claimed by City of Seattle

Appearing before the Utilities Committee of the Seattle City Council, H. O. Pond, of New York City, asked that some action be taken by the city formally notifying the district forester at Portland that the city has no intention of filing on or developing the Sultan River power project. The City of Seattle has first claim on this site, but has announced its intention of giving it up; and such formal notice to the district forester would leave the way open for action by the Sound Paper Co., represented by Mr. Pond, to file for power rights. It is the intention of the company to develop the Sultan project for power purposes to operate a paper mill to cost eventually $12,000,000, which includes the construction of a power plant, paper mills and a logging railroad, together with sawmills, etc. The company has secured options on timber which would give it 400,000 ft. of timber per day.

FIRE IN ATLANTA, STARTING AT CORNER OF DECATUR AND FORT STS., NEAR

Fire Destroys Fifty Blocks of Residences in Atlanta

Conflagration Lasting Eleven Hours Burns Over 1500 Buildings in Home District

A fire that started about noon on May 21 in a warehouse near the dividing line of the business and residential districts of Atlanta, Ga., was driven by high winds into the heart of a low-grade residential district and, raging beyond control until nearly midnight, burned through this district and a newer residential district of frame houses of the better sort. The conflagration was stopped just short of one of the best residential sections of the city, by ruthless dynamiting of houses. The total area burned over was about 50 city blocks, and the number of buildings destroyed is estimated at 1500. First estimates of loss run about $4,000,000; but fortunately only one life was lost, and the number of casualties is surprisingly small.

The fire started—simultaneously with two other rather sizable fires in other parts of the city—in a building near the corner of Decatur and Fort Sts., and under the pressure of a high northeast wind soon set fire to the immediately adjacent timber shacks and houses habited by negro residents. These structures made good fuel, and the burning brands, carried northeasterly, caught the shingle roofs of the frame residences lying north of Edgewood Ave. From here the progress was northerly over an area about five blocks wide to Ponce de Leon Ave., nearly 20 blocks away. The houses here, practically all of the frame, attached type, were completely destroyed, nothing being left except metal fixtures, brick chimneys and stone foundations. The devastation is well pictured in the accompanying view. The fire was fought by the entire fire department of Atlanta and with companies from 15 neighboring cities. On account of the high wind and the ready transfer of small fires by brands catching wooden shingles, the fire fighting was almost futile, and final stopping of the fire was probably due to the making of a cleared area by dynamiting.

Allen Is New Engineering Dean of Minnesota University

Prof. John R. Allen, head of the mechanical engineering department of the University of Michigan, will be dean of the College of Engineering and Architecture at the University of Minnesota, succeeding Dean Francis C. Shenehon, who retired May 1 for private engineering work. Dean Allen will begin his work in Minnesota Aug. 1. He is recognized as an expert in heating and ventilating engineering, which subject has received special attention in the University of Minnesota.

Cleveland Engineer Regiment Is Now Assured

Cleveland's regiment of engineers became an actuality May 23, when Lieut. Col. J. R. McQuigg announced that the last man needed for Company F had been signed up. This result, attained in six weeks' endeavor on the part of Colonel McQuigg and volunteers from the ranks of the newly enlisted men, brings two new Cleveland companies into being and gives the city a complete engineering regimental unit. A large number of men will be required to bring the organization to full war strength, but completion of primary enlistment means that the regiment will be accepted by the Government and may see early service.

Seasonal Storm Damages Eight States

Little Damage To Engineering Structures Is Reported—Many Lives Lost

Sweeping through Illinois, Indiana, Kansas, Kentucky, Missouri, Tennessee, Alabama and Arkansas, the storm which rose Saturday, May 26, accomplished much money damage and claimed a toll of over 300 deaths. The reports which are coming in daily serve to spread the area over which its force was felt and to add to the long list of towns and villages which were partially or totally destroyed.

No large city seems to have been damaged, though cities of the third class, like Matoon, Ill., had thousands of their citizens made homeless and many of their industries crippled or destroyed. Up to Tuesday morning, no reports had been received which indicated any damage to engineering structures. While frame residences seemed unable to withstand the weight of the storm, it seems probable that the more solidly constructed brick buildings suffered mainly through having roofs blown off.

Elect Bush Head of Reorganized Missouri Pacific R.R.

On May 17, Benjamin F. Bush, receiver of the Missouri Pacific-Iron Mountain system, was elected president of the new Missouri Pacific Railroad Co., which in a few weeks will take over the lines of the combined system. Other officers chosen were: Finley J. Shepard, of New York, vice president; A. Robertson, St. Louis, vice president in charge of operation and construction; J. G. Drew, St. Louis, vice president in charge of accounts; Edward J. White, St. Louis, vice president and general solicitor, and H. M. Adams, St. Louis, vice president in charge of traffic.

LEFT OF VIEW, SWEPT BACK AND TO RIGHT, DESTROYING 50 BLOCKS OF RESIDENCES

Florida Creates Board of Engineering Examiners

Recognizes Experience as a Necessary Precedent to Responsibility

The act providing for the creation and maintenance of a Florida State Board of Engineering passed the recent session of the legislature and automatically became a law through the neglect of the governor in neither signing nor vetoing it. The law is practically copied from the draft prepared by the joint committee of the national engineering societies and received the support of most Florida engineers. In fact, the only definite opposition to the bill came from within the profession itself and was traceable to many differing individual opinions as to certain clauses. There was, however, a general support for the basic idea of the legislation.

Three Civil Engineers on Board

The law provides that the examining board shall consist of three civil engineers, one mining or electrical engineer and one mechanical or naval engineer, whose terms, after the period of establishment, are to be for four years. The members receive no salary, but are allowed necessary expenses. These and the salaries of such employees as may be found necessary are to be taken from the examination and renewal fees.

Anyone over 21 years of age, who is of good character and who has been engaged in engineering work for six years, during which period he must have been for one year in charge as principal or assistant, shall be admitted to examination upon payment of $15. Graduation from a recognized engineering school counts for two years of experience, but does not eliminate the necessity for experience in charge of work. If the examination, which may be oral or written, is passed satisfactorily, a certificate will be issued by the board upon payment of $10. Engineers from states having an engineering board of examiners maintaining as high standards as Florida are to be admitted to practice, without examination, upon payment of a fee of $25. To continue in practice, a yearly fee of $5 must be paid.

Another provision of the law makes it a misdemeanor for an engineer to profit from the use of any material in a structure designed by him. No provision of the act relates to United States Government engineers or to anyone acting as an assistant to a professional engineer.

Connecticut Health Work To Be Reorganized

By July 1, 1917, Connecticut will join the growing number of states whose public-health work is handled by a commissioner and a public-health council, who with bureau directors will constitute a State Department of Health. The commissioner, who is to be chairman of the council, will be appointed by the governor for a term of four years at a salary of $4000 a year. He must be a physician "skilled in sanitary science and public-health administration," and must not "engage in any other occupation."

The council will consist of six members, in addition to the commissioner. The members will be appointed by the governor and will serve without pay, except for expenses. The council must establish a sanitary code, which "may provide for the preservation and improvement of the public health." The council is authorized "to prescribe the qualifications of the directors of bureaus and all other appointees," but the appointments are made by the commissioner and the appointees are subject to his direction. The council also fixes the compensation of bureau directors, subject to the approval of the State Board of Control. There will be bureaus of vital statistics, preventable diseases, laboratories and sanitary engineering. The commissioner will "have authority over" local health officers and may remove them for cause, with the assent of the council, but subject to court appeal. Local health officers and boards must enforce or help enforce the state sanitary code. Local boards may pass sanitary rules or regulations already authorized by law, not inconsistent with the state code.

Gen. Goethals To Build Merchant Marine of Steel Ships

Tells Steel Men That Wooden-Ship Scheme Seems Impracticable

In a speech distinguished by two notable epigrams, Gen. George W. Goethals, speaking as general manager of the Emergency Fleet Corporation, assured the members of the American Iron and Steel Institute on May 25 that he would undertake to construct 3,000,000 tons of steel ships in 18 months and that, frankly, the original wooden-ship scheme of the Shipping Board was hopeless. General Goethals said that he had not found any definite program of wooden-ship construction in the board. "When it is considered," he continued, "that birds are still nesting in the trees from which the great wooden fleet was to be made, and it was proposed to construct from them ships capable of making from 10 to 11 knots per hour—and more than that when in the zone in which existed dangers from torpedoes—it is seen how hopeless the task appeared." The general then sought the aid of the steel manufacturers, and upon assurance from them of delivery of material, he went before Congress with the steel-ship program outlined above. General Goethals' main comment regarding the Shipping Board and his relations with it was that he "regarded all boards as long, narrow and wooden."

Engineering Societies

The Engineers' Society of Western Pennsylvania held its regular monthly meeeting Tuesday evening, May 29. J. C. Hobbs, assistant to the superintendent of power stations, Duquesne Light Co., Pittsburgh, delivered a paper, "An Efficient Gas-Fired Boiler Installation," which was illustrated with lantern slides.

The Albany Society of Civil Engineers, at its regular meeting, Tuesday evening, May 22, was addressed by J. W. Pfau, construction engineer of the New York Central R.R., on "The Past and Future Growth of Railroad Facilities in and About Albany." Mr. Pfau also spoke of the proposed connecting railroad to be constructed across the Hudson River in the vicinity of Castleton.

The Providence (R. I.) Engineering Society announces that on Friday, June 1, Frank B. Gilbreth will deliver a lecture on "Time and Motion Study," and on Monday, June 4, Arthur Lee, principal of the Providence Technical High School, will talk on "The Relation of the Technical High School to the Industries of the City." At the regular May meeting, Monday, May 28, John R. Freeman delivered an illustrated lecture on his travels in the Orient; on Thursday, May 24, Ensign W. W. Bailey, U. S. N., delivered a lecture on "Signals," and on Friday, May 25, Paul S. Smith, chief chemist of the O'Bannon Corporation, spoke on the subject of nitro-cellulose explosives. Mr. Smith's talk was illustrated with many lantern slides.

The Society of Terminal Engineers will hold its first regular meeting in New York, in the United Engineering Societies Building, 29 West 39th St., on Tuesday evening, May 29, at 8 o'clock. Special papers on terminal engineering and mechanical freight and material handling will be read. Special committees will be appointed and a program adopted for the future work of the society. J. H. Leonard, 1133 Broadway, New York, is secretary.

The Oregon Society of Engineers held a port week meeting on May 18 at Portland, Ore., at which G. B. Hegardt, secretary and engineer of the Commission of Public Docks, addressed the society on the proposed bond issue for grain elevator and freight terminals. The lecture was illustrated with lantern slides, showing the development of the Columbia River bar and channel from the first surveys to the present time.

The Cleveland Engineering Society, at the annual meeting held recently, elected James H. Herron president for the ensuing year. The other officers will be: Vice president, E. B. Thomas; directors, F. D. Richards, G. E. Merryweather and F. A. Vaughan. Honorary memberships were voted to Ambrose Swasey and S. T. Wellman. The new officers will be installed and the honorary memberships conferred at the annual dinner which will be held June 12.

Personal Notes

Norman M. Stineman, of Chicago, has resigned his position as office engineer of the Chicago, Milwaukee & St. Paul Ry., to become engineer of reinforced concrete of the La Salle Engineering Co., Chicago.

Harrison W. Craver has been appointed director of the technical library in the Engineering Building, New York, formed by the consolidation of the libraries of the American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Mining Engineers and American Institute of Electrical Engineers. Mr. Craver was formerly librarian of the Carnegie Library in Pittsburgh, Pennsylvania.

Theodore Bloecher, Jr., has been appointed division engineer in Philadelphia by the Baltimore & Ohio R.R., succeeding G. F. Eberly, transferred.

McHenry & Murray, of New Haven, Conn., have dissolved their engineering partnership. Mr. Murray will hereafter devote his time to the Housatonic Power Co., of which he is the president, Mr. McHenry retiring to private life.

Grant M. Lorraine has been appointed city engineer of Alhambra, Calif., succeeding Charles Hewes, who is now city manager. Mr. Lorraine was formerly city engineer of Orland, California.

E. W. Kelly and **Langdon Pearse**, engineers of the Sanitary District of Chicago, started on a trip, May 19, through the South, to inspect plants for the disposal of sewage, stockyards and industrial wastes. Fort Worth, Kansas City, Houston and Galveston are on the schedule.

Harry Watts, formerly with the Texas Construction Co., is now with the H. W. Cardwell Construction Co., in Marlin, Texas.

C. E. Johnson has been appointed city engineer and **James S. McNair**, street superintendent, of San Bernardino, California.

Capt. Charles T. Leeds (retired), Corps of Engineers, U. S. A., has been assigned to active duty in charge of the United States District Engineer Office at Los Angeles, succeeding Maj. George B. Pillsbury. In the work of organizing the engineer enlisted reserve corps in this district he will be assisted by Capt. A. H. Archer, Corps of Engineers, U. S. A. Permission has been granted by the chief of engineers for the continuation of business of the firm of Leeds & Barnard, consulting engineers, by Mr. Barnard under the firm name. The active work will be handled by Mr. Barnard in consultation with Captain Leeds on such matters as shall not affect his duties as United States district engineer officer.

Frederic Bass, consulting engineer, Minneapolis, has been retained by the attorney general of the State of Minnesota in the suit that North and South Dakota have filed against Minnesota alleging damage of $1,000,000 from flooding of valuable lands in the valley of the Red River near its source in Lake Traverse.

Mark M. Trumbull, formerly with the Illinois Highway Commission, designing and constructing reinforced-concrete and steel bridges, is now assistant to George L. Farnsworth, who is city engineer of Ottawa, Ill., and superintendent of highways for La Salle County.

John A. Guissinger has left the service of the Missouri Pacific System and is engaged in highway work at Wynne, Ark., as resident engineer for C. B. Bailey, who is consulting engineer for Cross County Road District No. 1.

Carl H. Reeves, consulting engineer, Seattle, has entered into a contract with Paul P. Whitham, consulting engineer, formerly of Seattle (now Federal trade commissioner for the United States Government in the Orient), and the Clallam County Commissioners, to prepare a comprehensive scheme of development for the port of Los Angeles. This contract was held by Mr. Whitham until his appointment. All of Mr. Whitham's affairs in Seattle will be cared for by Mr. Reeves.

Col. George P. Howell, Corps of Engineers, U. S. A., who has been stationed at Little Rock, Ark., in charge of the Arkansas River, will succeed Maj. M. J. McDonough as engineer in charge of the Mississippi River district, extending from Cape Giradeau to Arkansas City. Major McDonough, who was ordered to leave last week for Plattsburg, N. Y., to become instructor at the training camp, received further orders to remain in Memphis until the arrival of Colonel Howell.

Hunley Abbott, vice president and chief engineer of the MacArthur Concrete Pile and Foundation Co., has resigned to assume a connection with Bartlett Hayward Co., founder and engineer, of Baltimore, Md. Mr. Abbott is the inventor of the pedestal concrete pile and was instrumental in forming the MacArthur Concrete Pile and Foundation Co., with which he has been associated as an officer since its inception nine years ago.

Robert H. Jacobs, division engineer of the New York State Public Service Commission, has assumed supervision of track design and of all contracts for the purchase of materials in connection with the work of supervision of track construction, vice Ellsworth L. Mills, resigned.

Ralph W. Whitaker has been appointed city engineer of Bakersfield, Calif., to succeed R. B. Ray, who has held the position for the last two years.

Charles M. Upham, Georgetown, Del., has been appointed chief engineer of the State Highway Commission. Mr. Upham has been county engineer of Sussex County and chief engineer for the Coleman du Pont Road, Inc. George W. Francis, Wilmington, a graduate civil engineer from Delaware College, has been appointed secretary to the commission.

E. J. Carrell, who has been district engineer of maintenance-of-way of the southwest district, Baltimore & Ohio R.R., becomes superintendent of the Delphos division.

George McKnight, city engineer of Fredericton, N. B., has tendered his resignation, to take effect June 1.

B. E. Michel has been appointed city engineer at Kitchener, Ont., to succeed H. Johnston.

F. F. Backus, lately assistant to the president of the Toronto, Hamilton & Buffalo Ry., has been appointed general manager.

C. L. Leighty, inspector of transportation for the Eastern lines of the Canadian Pacific Ry., has been appointed superintendent of the Canadian Pacific Telegraph, Ontario division, with headquarters at Toronto.

William D. Weightson, sanitary engineer for the Public Health Service, United States Treasury Department, is now making surveys and analyses of water-supplies to be used for drinking purposes on interstate common carriers.

Edmund Lynch, resident engineer for Chester & Fleming, of Pittsburgh, is now located at Alliance, Ohio, in charge of the construction of a booster station and of improvements to the present pumping station.

Carl L. Weil, formerly with the Public Service Commission, New York City, is now field engineer for Westinghouse Church Kerr & Co., superintending the construction of railroad shops at Salamanca, N. Y., for the Buffalo, Rochester & Pittsburgh Railway.

William R. Phillips, for the past three years general manager of the Eastern division of the Austin Co., has now opened offices in the Newfield Building, Bridgeport, Conn., as constructing engineer, and will specialize in the erection of industrial plants and factory buildings.

Dudley T. Corning, assistant engineer, Bureau of Highways and Street Cleaning, Philadelphia, Penn., has been appointed division engineer in the newly created Bureau of Street Cleaning. Mr. Corning, prior to his going to Philadelphia, was civil engineer with the Cambria Steel Co., Johnstown, Penn., and manager of its subsidiary concerns—the Cambria Inclined Plane Co. and the Manufacturers Water Company.

J. S. Lemond, formerly engineer maintenance-of-way of the Southern Ry., Eastern district, has been promoted to assistant to chief engineer maintenance-of-way and structures, lines East, at Charlotte, N. C.; **G. E. Buckley,** formerly engineer maintenance-of-way, Northern district, Richmond, Va., has been transferred to the Eastern district to succeed Mr. Lemond; **G. L. Sitton,** formerly resident engineer of the Northern district, at Richmond, has been promoted to engineer maintenance-of-way, Northern district, succeeding Mr. Buckley; and **O. D. Colaw,** formerly inspector at Washington, has been appointed resident engineer, Northern district, at Richmond, succeeding Mr. Sitton.

William Herbert Vance, who has been appointed engineer maintenance-of-way of the St. Louis Southwestern Ry., was graduated in civil engineering from the University of Illinois in 1899. He entered the service of the United States Government, being employed as inspector and overseer of the improvement work on the Illinois River. From March, 1902, to February, 1905, he was assistant of the engineering corps of the Peoria & Eastern Ry., then assistant division engineer of the Missouri division of the St. Louis, Iron Mountain & Southern Ry. for one year, and then from June, 1906, until October, 1909, division engineer of the Louisiana & Arkansas R.R. He was advanced to the position of engineer maintenance-of-way in November, 1909, and seven years later was made chief engineer. He resigned as chief engineer of the Louisiana & Arkansas R.R. in March, 1917, to accept his present office with the St. Louis Southwestern Railway.

E. L. Martin, resident engineer of the Missouri, Kansas & Texas Ry. at San Antonio, Tex., has been appointed engineer maintenance-of-way, with headquarters at Dallas, succeeding A. A. Matthews, transferred.

Francis C. Shenehon, for the past eight years dean of the College of Engineering of the University of Minnesota and head professor of civil engineering, has opened offices in the New Metropolitan Bank Building, Minneapolis, and will give his entire attention to his practice as a consulting hydraulic engineer. During the past seven years Mr. Shenehon has given some considerable portion of his time to work as a hydraulic engineer. He was engineering expert for the United States Government in connection with the Chicago Sanitary Canal and in the condemnation of the water power, 40,000 hp., in St. Marys River, the outlet of Lake Superior, and consulting engineer to Hydraulic Power Co. at Niagara Falls.

Robert C. Terrell, former commissioner of public roads of Kentucky, who has been connected with the department of civil engineering at the University of Oklahoma, at Norman, has been promoted to the rank of associate professor in charge of the new department of highway engineering, which is to be a branch of the School of Civil Engineering in the College of Engineering at the university.

H. B. Ullian and **S. Goldman,** specializing in land development and subdivision work, have opened a new office at 612 Congress Building, Detroit, under the firm name of Goldman & Ullian.

Obituary

Lieutenant William J. Withrow, of Toronto, a distinguished graduate of the School of Practical Science, Toronto University, in civil engineering, has been killed in France. He held a position in the civil engineering department at Ottawa and a year ago enlisted with a machine-gun detachment. On arriving in France he was appointed lieutenant in charge of the topographical department, with a staff of 30 men.

Roscoe B. Kendig, chief mechanical engineer of the New York Central R.R., died suddenly on Thursday, May 10, in Detroit, Mich., where he was attending a conference with the officials of the Michigan Central Ry. Mr. Kendig was in his 50th year and was in the employ of the Pennsylvania and Lake Shore & Michigan Southern railroads as mechanical engineer before joining the New York Central.

Gaston Daus, district sales manager for the Edison Portland Cement Co. at Philadelphia, died on Apr. 15 at his home in that city. He was born in Baltimore in 1869. At the start of his business career he was connected with the J. B. King Co., New York City, and later with the Lesley & Trinkle Co., Philadelphia, for 23 years, 11 of which he served in the capacity of sales manager. For four years preceding his employment by the Edison Co. he was district sales manager for the Lehigh Portland Cement Co.

Business Notes

Dilworth, Lockwood & Co., 260 West St., New York City, steel merchants, have secured the services of Ellsworth L. Mills, formerly head of the track division of the New York State Public Service Commission.

Dowler, Forbes & Co., exporters, of New York, Canton, Shanghai and London, have secured the services of Walter Brunswick, formerly connected with the sales department of the American Locomotive Co. Mr. Brunswick will assume charge of the engineering department .

The New Jersey Slag Co., recently organized for the purpose of crushing

and marketing the slag banks of the Wharton Steel Co., at Wharton, N. J., is composed of F. K. Sheesley, of Johnstown, Penn.; A. D. P. Janney, of Philadelphia, and E. G. Lewis, who has been for the last 10 years with the Bucyrus Steam Shovel Co. and the General Equipment Co.

Robert W. Hunt & Co., inspecting engineers, of Chicago, have offered their services to the Secretary of the Navy on terms of actual cost of work done. With offices and laboratories in several cities, and with inspectors stationed at many of the principal manufacturing plants, the company is well equipped to render prompt and effective service in the inspection of materials and manufactures for the Government.

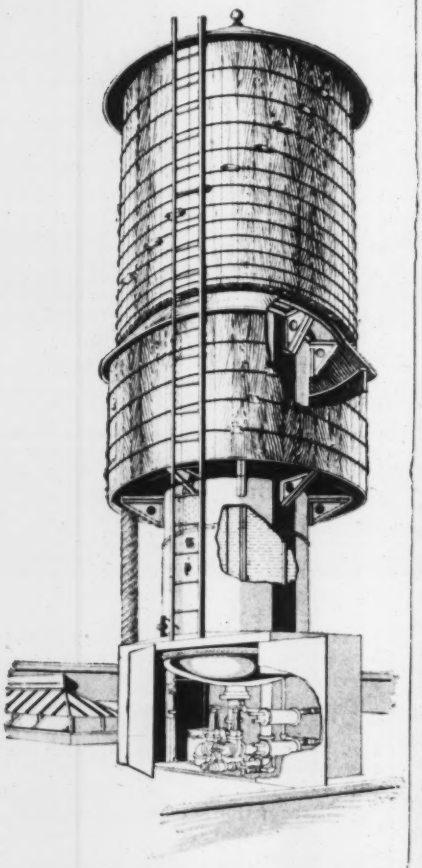
The Walter A. Zelnicker Supply Co. announces that at a meeting of the board of directors, held Apr. 19, A. R. Topping, who has been associated with the company for 11 years, was elected secretary.

Appliances and Materials

Gravity, Pressure and House-Service Tanks Combined

A type of structure that combines the various supply tanks ordinarily found on a loft-building roof has been developed by E. C. Maxwell Co., 146 24th St., Brooklyn, N. Y. The scheme is shown in the accompanying sketch. A stiffened closed pressure tank stands vertically on the roof. Around the pressure-tank cylinder and supported by it is a wooden gravity-supply tank. Above the gravity-supply tank and supported by the pressure cylinders is a second wooden open tank—for the standpipe and house supply.

Automatic air-compressor and pump outfits keep the water level and tank pressure fixed. A water-leg comes down through the pressure tank, and through this the sprinkler system is connected by an outlet pipe; this last in turn is connected to the pressure tank through check and control valves. A heavily insulated pipe comes down from the upper tank to the standpipe and house line. Steam heaters keep the pressure and gravity tanks from freezing, and this in turn warms the house tank.



THREE ROOF TANKS COMBINED INTO ONE STRUCTURE

Wall Board Now Moisture-Proof

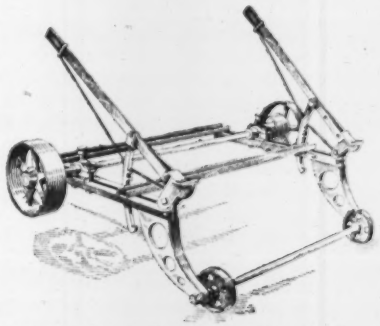
A patent process of surface sizing for paper-composition building board, making it impervious to moisture, has been developed by the Beaver Board Co., of Buffalo, N. Y. This treatment eliminates the effect of atmospheric changes, prevents bulging and avoids the necessity of a priming coat of paint.

Automatic Valve Drains Construction Engine Cylinders

An automatic drain valve for relieving steam-engine cylinders of condensation, which accumulates particularly in starting small construction equipment, has been devised by P. J. Dielman, of the Dielmore Co., Tacoma, Wash. The valve body has three ports, one being connected to the steam chest and the others to the cylinder ends. It discharges to any waste pipe. The valve proper is held off its seat by a spring and is closed by steam from the chest as soon as water ceases to come from the cylinders.

Motor Car As Auxiliary Power

A steel jacking frame to be used under the rear axle housing of a Ford or other light automobile so that the car may be used for giving emergency or occasional power, and known as the "Helping Henry," is being made by the Auto Power Co., of Laporte, Ind. The

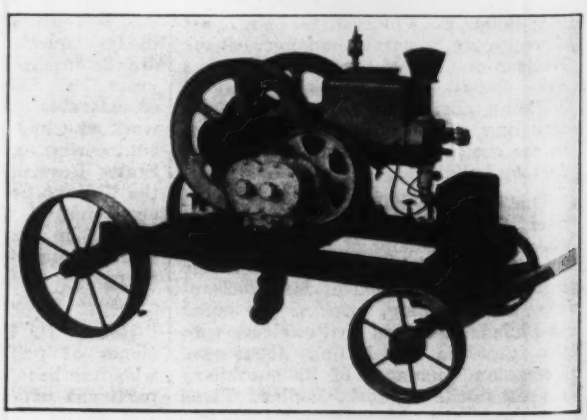


MAKES POWER OF FORD AVAILABLE

rear wheels are lifted off the ground and the tire treads brought to bear against wide-rim pulleys on a countershaft. A belt pulley is placed on the shaft and a belt run off wherever needed.

Portable Road-Oil Power Pump

The portable pumping outfit shown in the accompanying view is intended for unloading road oil from tank-cars and delivering it to the tank wagons or motor trucks that distribute the oil on the road. The 2½-in. suction (below the pump) is connected by a pipe to the outlet of the tank-car. To the 2½-in. discharge (above the pump casing) is fitted a pipe with horizontal branch and hose for delivery to the manhole of the wagon or truck. A horizontal gasoline engine of 4 hp. drives the pump impellers by means of a chain and sprocket wheel. The capacity is about 75 gal. per min. with light oils, or 60 gal. per min. with heavy oils, and an ordinary 600-gal. tank wagon can be filled in 7 to 10 min. The outfit is built by the C. H. & E. Manufacturing Co., Milwaukee, Wisconsin.



FILLS 600-GAL. TANK WAGON IN 10 MIN.